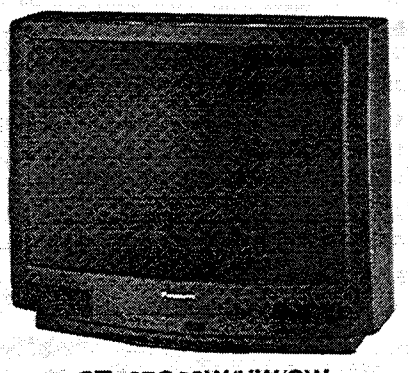
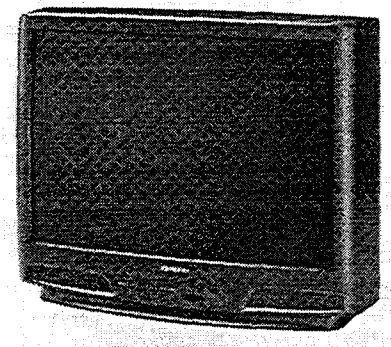
ORDER NO. MTC9803754C1
B5

Service Manual

Color Television



CT-27G23W/UW/CW



SP2721W/UW

Main Manual (NA6LM)

Panasonic

Models	Chassis
CT-27G23W/UW	**AEDP307**
CT-27G23CW	**ASEDP307**

Quasar

Models	Chassis
SP2731W/UW	**ANEDC307**

NOTE: Model **CT-27G23UW** is identical to model **CT-27G23W**, and model **SP2731UW** is identical to model **SP2731W** except for the magnetic field used in the factory to adjust **purity** and **convergence** for different markets.

This **Service Manual** is issued as a service guide for the models of the NA6LM family listed above. Included in this manual are a set of schematics, alignment procedures, block diagrams and a complete parts list.

Note: Please refer to **NA6D/L Technical Guide (MTC9702684G1)** for more functional descriptions and block diagrams.

"**WARNING!** This Service Manual is designed for experienced repair technicians only and is not designed for use by the general public. It does not contain warnings or cautions to advise non-technical individuals of potential dangers in attempting to service a product. **Products powered by electricity should be serviced or repaired only by experienced professional technicians.** Any attempt to service or repair the product or products dealt with in this Service Manual by anyone else could result in serious injury or death."

The service technician is required to read and follow the "**Safety Precautions**" and "**Important Safety Notice**" in this manual.

Panasonic ®

Important Safety Notice

Special components are used in this television set which are important for safety. These parts are identified on the schematic diagram by the symbol ⚠ and printed in **BOLD TYPE** on the replacement parts list. It is essential that these critical parts are replaced with the manufacturer's specified replacement parts to prevent X-ray radiation, shock, fire or other hazards. Do not modify the original design without the manufacturer's permission.

Safety Precautions

General Guidelines

An **Isolation Transformer** should always be used during the servicing of a receiver whose chassis is not isolated from the AC power line. Use a transformer of adequate power rating as this protects the technician from accidents resulting in personal injury from electrical shocks. It will also protect the Receiver from being damaged by accidental shorting that may occur during servicing.

When servicing, observe the original lead dress, especially in the high voltage circuit. Replace all damaged parts (also parts that show signs of overheating.)

Always Replace Protective Devices, such as fishpaper, isolation resistors and capacitors, and shields after servicing the Receiver. Use only manufacturer's recommended rating for fuses, circuit breakers, etc.

High potentials are present when this Receiver is operating. Operation of the Receiver without the rear cover introduces danger from electrical shock. Servicing should not be performed by anyone who is not thoroughly familiar with the necessary precautions when servicing high-voltage equipment.

Extreme care should be practiced when **Handling the Picture Tube**. Rough handling may cause it to implode due to atmospheric pressure (14.7 lbs per sq. in.). Do not nick or scratch the glass or subject it to any undue pressure. When handling, use safety goggles and heavy gloves for protection. **Discharge the picture tube** by shorting the anode to chassis ground (not to the cabinet or to other mounting hardware). When discharging, connect cold ground (i.e. dag ground lead) to the anode with a well insulated wire or use a grounding probe.

Avoid prolonged exposure at close range to unshielded areas of the picture tube to prevent exposure to X-ray radiation.

The **Test Picture Tube** used for servicing the chassis at the bench should incorporate safety glass and magnetic shielding. The safety glass provides shielding for the tube viewing area against X-ray radiation as well as implosion. The magnetic shield limits X-ray radiation around the bell of the picture tube in addition to restricting magnetic effects. When using a picture tube test jig for service, ensure that the jig is capable of handling **36.8kV** without causing X-ray radiation.

Before returning a serviced receiver to the owner, the service technician must thoroughly test the unit to ensure that it is completely safe to operate. **Do not use a line isolation transformer when testing**.

Leakage Current Cold Check

Unplug the AC cord and connect a jumper between the two plug prongs.

Measure the resistance between the jumpered AC plug and exposed metallic parts such as screwheads, antenna terminals, control shafts, etc. If the exposed metallic part has a return path to the chassis, the reading should be between 240kΩ and 5.2MΩ. If the exposed metallic part does not have a return path to the chassis, the reading should be infinite.

Leakage Current Hot Check (See Figure 1)

Plug the AC cord directly into the AC outlet. Do not use an isolation transformer during the check.

Connect a 1.5kΩ 10 watt resistor in parallel with a 0.15μF capacitor between an exposed metallic part and ground. Use earth ground, for example a water pipe.

Using a DVM with a 1000 ohms/volt sensitivity or higher, measure the AC potential across the resistor.

Repeat the procedure and measure the voltage present with all other exposed metallic parts.

Verify that any potential does not exceed 0.75 volt RMS. A leakage current tester (such as a Simpson Model 229, Sencore Model PR57 or equivalent) may be used in the above procedure, in which case any current measure must not exceed 1/2 milliamp. If any measurement is out of the specified limits, there is a possibility of a shock hazard and the Receiver must be repaired and rechecked before it is returned to the customer.

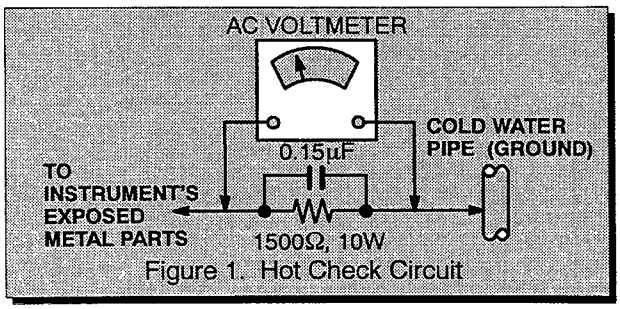


Figure 1. Hot Check Circuit

X-ray Radiation

WARNING: The potential source of X-ray radiation in TV sets is in the High Voltage section and the picture tube.

NOTE: It is important to use an accurate, calibrated high voltage meter.

Set the **brightness, picture, sharpness** and **color** controls to Minimum.

Measure the High Voltage. The high voltage meter should indicate **28.4kV ±1.25kV**. If the upper limit is out of tolerance, immediate service and correction is required to insure safe operation and to prevent the possibility of premature component failure.

Horizontal Oscillator Disable Circuit Test

This test must be performed as a final check before the Receiver is returned to the customer. See **Horizontal Oscillator Disable Circuit Procedure Check** in this manual.

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Service Notes

NOTE: ***These components are affixed with glue. Be careful not to break or damage any foil under the component or at the pins of the ICs when removing. Usually applying heat to the component for a short time while twisting with tweezers will break the component loose.***

Leadless Chip Components (surface mount)

Chip components must be replaced with identical chips due to critical foil track spacing. There are no holes in the board to mount standard transistors or diodes. Some chip capacitor or resistor board solder pads may have holes through the board, however the hole diameter limits standard resistor replacement to 1/8 watt. Standard capacitors may also be limited for the same reason. It is recommended that identical chip components be used.

Chip resistors have a three digit numerical resistance code – 1st and 2nd significant digits and a multiplier. Example: 162 = 1600 or 1.6KΩ resistor, 0 = 0Ω (jumper).

Chip capacitors generally do not have the value indicated on the capacitor. The color of the component indicates the general range of the capacitance.

Chip transistors are identified by a two letter code. The first letter indicates the type and the second letter, the grade of transistor.

Chip diodes have a two letter identification code as per the code chart and are a dual diode pack with either common anode or common cathode. Check the parts list for correct diode number.

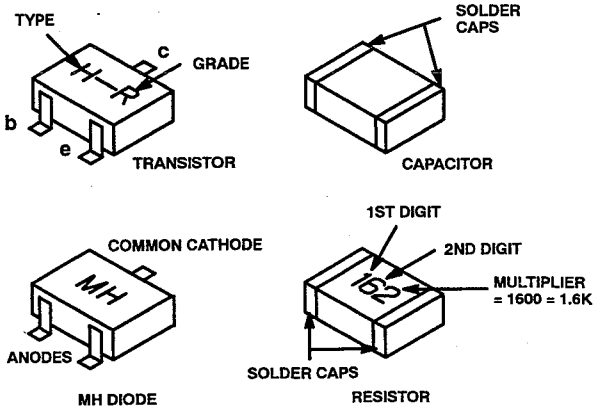
Component Removal

1. Use solder wick to remove solder from component end caps or terminals.
2. Without pulling up, carefully twist the component with tweezers to break the adhesive.
3. Do not reuse removed leadless or chip components since they are subject to stress fracture during removal.

Chip Component Installation

1. Put a small amount of solder on the board soldering pads.
2. Hold the chip component against the soldering pads with tweezers or with a miniature alligator clip and apply heat to the pad area with a 30 watt iron until solder flows. Do not apply heat for more than 3 seconds.

Chip Components

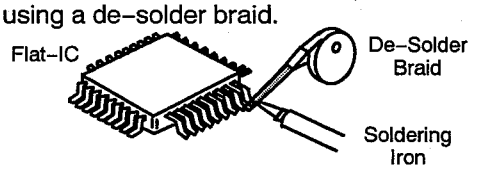


How to Replace Flat–IC

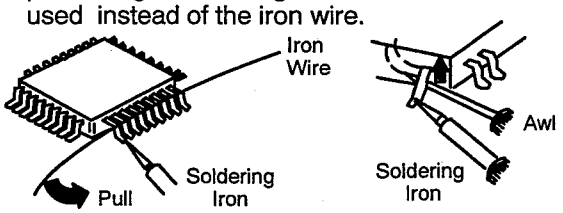
– Required Tools –

- Soldering iron
- De–solder braids
- Iron wire or small awl
- Magnifier

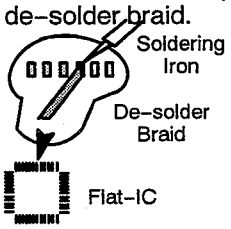
1. Remove the solder from all of the pins of a Flat–IC by using a de–solder braid.



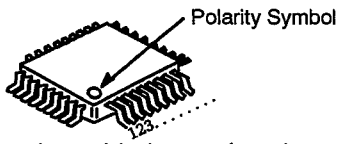
2. Put the iron wire under the pins of the Flat–IC and pull it in the direction indicated while heating the pins using a soldering iron. A small awl can be used instead of the iron wire.



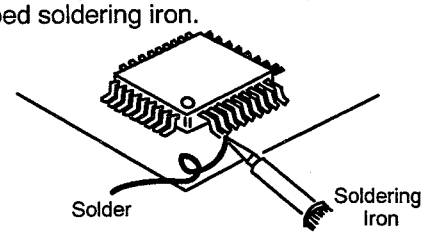
3. Remove the solder from all of the pads of the Flat–IC by using a de–solder braid.



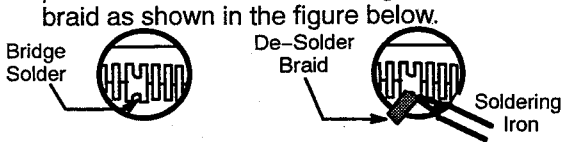
4. Position the new Flat–IC in place (apply the pins of the Flat–IC to the soldering pads where the pins need to be soldered). Properly determine the positions of the soldering pads and pins by correctly aligning the polarity symbol.



5. Solder all pins to the soldering pads using a fine tipped soldering iron.



6. Check with a magnifier for solder bridge between the pins or for dry joint between pins and soldering pads. To remove a solder bridge, use a de–solder braid as shown in the figure below.



Service Notes (Continued)

IMPORTANT: To protect against possible damage to the solid state devices due to arcing or static discharge, make certain that all ground wires and CRT DAG wire are securely connected.

CAUTION: The power supply circuit is above earth ground and the chassis cannot be polarized. Use an isolation transformer when servicing the Receiver to avoid damage to the test equipment or to the chassis. Connect the test equipment to the proper ground (⏚) or (⏚) when servicing, or incorrect voltages will be measured.

WARNING: This Receiver has been designed to meet or exceed applicable safety and X-ray radiation protection as specified by government agencies and independent testing laboratories.

To maintain original product safety design standards relative to X-ray radiation and shock and fire hazard, parts indicated with the symbol ⚠ on the schematic must be replaced with identical parts. Order parts from the manufacturer's parts center using the part numbers shown in this service manual, or provide the chassis number and the part reference number.

For optimum performance and reliability, all other parts should be replaced with components of identical specifications.

Horizontal Oscillator Disable Circuit

This chassis employs a special circuit to protect against excessive high voltage and beam current. If, for any reason, the high voltage and beam current exceed a predetermined level this protective circuit activates and detunes the horizontal oscillator that limits the high voltage.

The over-voltage protection circuit is not adjustable. However, if components indicated by the symbol ⚠ on the schematic in either the horizontal sweep system or the over-voltage protection circuit itself are changed, the operation of the circuit should be checked using the following procedure.

Equipment needed to check the disable circuit:

1. Voltmeter (0 - 200V scale)
2. High Voltage Meter (0 - 40kV)
3. Variac or Isolation Transformer

Procedure:

1. Tune in a station to verify that the horizontal is in sync.
2. Obtain a Monoscope pattern or a signal generator crosshatch pattern.
3. Connect the voltmeter (-) lead to TPD2 and the (+) lead to TPD1 (junction of D555 anode, R556 & R557). Set **Bright** level to (0) and **Picture** for a 1.8 volt reading on the voltmeter.
4. Turn the Receiver OFF. Connect a jumper across IC803 pin 3 and pin 4.
5. Reduce the AC supply voltage to approximately 45V. Connect the high voltage meter to the CRT anode (H.V. button). **NOTE:** Use the Dag Ground (C10 of the CRT Board) to connect the (-) lead of the meter.
6. Turn the Receiver ON. Slowly increase the AC supply voltage and verify that the high voltage does not exceed **34.5kV,** when horizontal just begins to pull out of sync. If the high voltage is not within the specified limit, the cause must be determined and corrected before the Receiver is returned to the customer.

Receiver Feature Table

FEATURE\MODEL	CT-27G23W/UW	CT-27G23CW	SP2731W/UW
Chassis	NA6LM	NA6LM	NA6LM
Tunning system	New 40K	New 40K	New 40K
# of channels	181	181	181
Menu language	ENG/SPAN/FR	ENG/SPAN/FR	ENG/SPAN/FR
Closed Caption	X	X	X
Picture in Picture (PIP)	1T	1T	1T
75 Ω input	X	X	X
Remote Model #	EUR511170	EUR511170	EUR511113
Picture tube	M68LGL061X	M68LGL061X	M68LGL061X
Notch filter	P	P	P
V/A norm (X=both)	V	V	V
MTS/SAP/DBX	X	X	X
AI Sound (DLX: *, SMPL: X)	X	X	N/A
Built-in audio power	1.5Wx2 (10%)	1.5Wx2 (10%)	1.5Wx2 (10%)
# of speakers	2	2	2
A/V in (rear/front)	1/0	1/0	1/0
Audio Output	VAO	VAO	N/A
Dimensions mm (HxWxD) in	600.0 x 665.0 x 534.0 23.62 x 26.18 x 21.02	600.0 x 665.0 x 534.0 23.62 x 26.18 x 21.02	600.0 x 661.0 x 534.0 23.62 x 26.02 x 21.02
Weight (kg/lb)	34.25 / 75.49	34.25 / 75.49	34.56 / 76.17
Power soruce (V / Hz)	120 / 60	120 / 60	120 / 60
Power consumption, Max (A)	1.8	1.8	1.8
Anode voltage	28.4kV ± 1.25kV	28.4kV ± 1.25kV	28.4kV ± 1.25kV
Video input jack	$1V_{p-p}$ 75Ω, phono jack	$1V_{p-p}$ 75Ω, phono jack	$1V_{p-p}$ 75Ω, phono jack
Audio input jack	500mV RMS 47kΩ	500mV RMS 47kΩ	500mV RMS 47kΩ
A-Board TNP2AH008	NIL	AF	AD
C-Board TNP2AA034	NIL	NIL	NIL
Y-Board TNP2AA009	NIL	NIL	NIL

Table 1. **Receiver Features**

Specifications are subject to change without notice or obligation.
Dimensions and weights are approximate.

Location of Controls (Receiver)

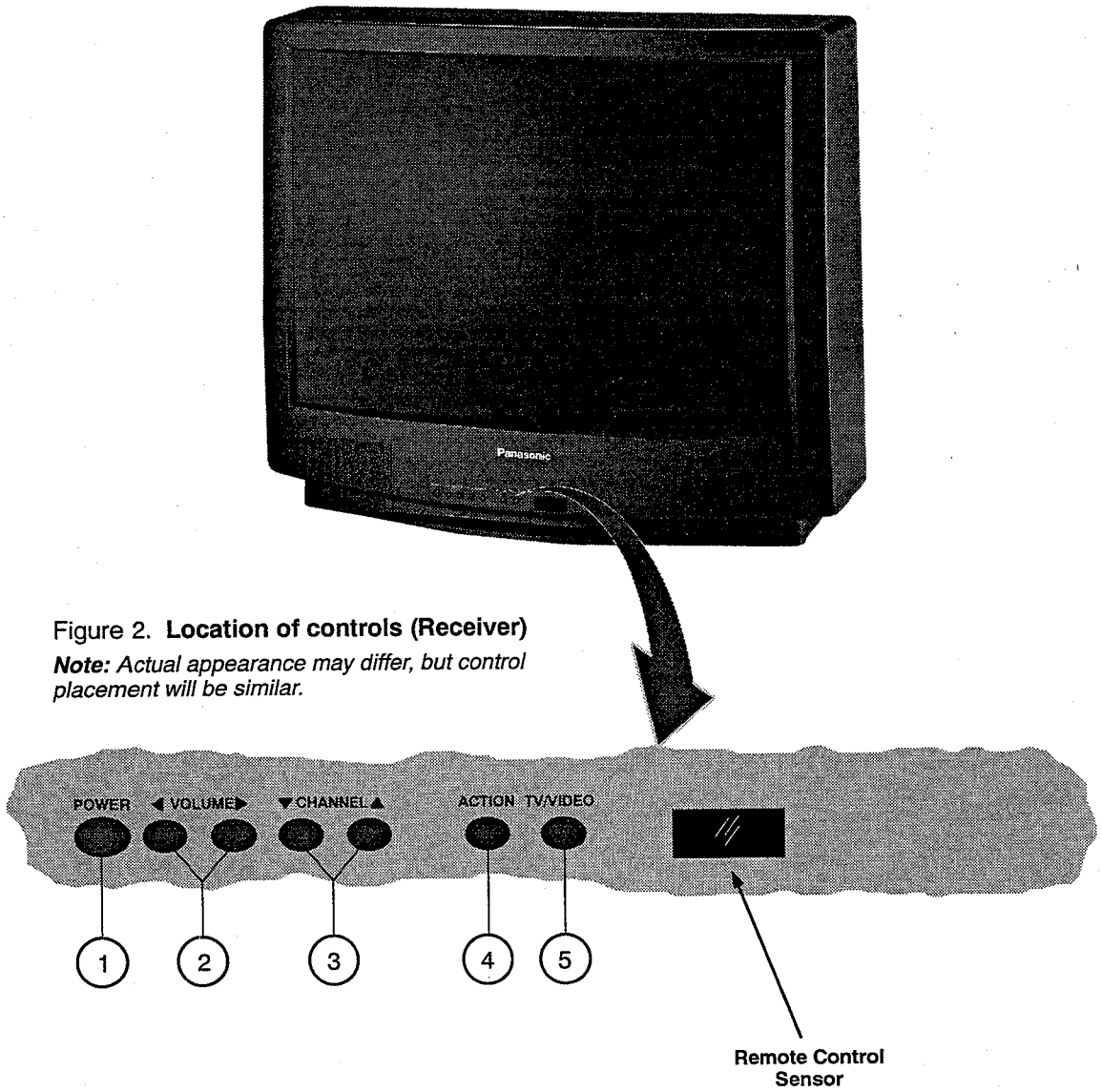


Figure 2. **Location of controls (Receiver)**

Note: *Actual appearance may differ, but control placement will be similar.*

(1) **Power Button** – Press to turn ON or OFF.

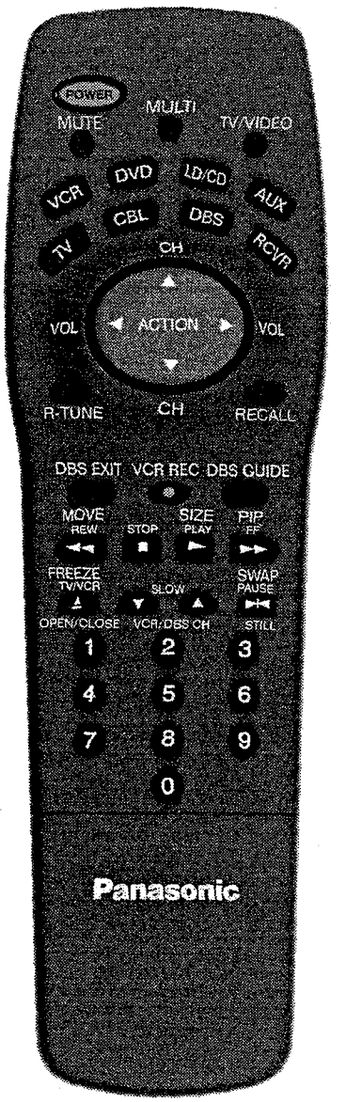
(2) **Volume Buttons** – Press to adjust Sound Level. Press to adjust Video Menus and select operating features when menus are displayed.

(3) **Channel Buttons** – Press to select programmed channels. Press to highlight desired features when menus are displayed.

(4) **Action Button** – Press to display Main Menu and access On Screen feature and Adjustment Menus.

(5) **TV/Video Button** – Press to select TV or Video Input.

Location of Controls (Remote)



EUR511170
(CT-27G23W/UW/CW)

Power Button
Press to turn ON or OFF.

TV/Video Button
Press to select TV or Video Input.

Mute Button
Press to mute sound. A second press resumes sound. Press also to access and delete Closed Caption display.

Channel Buttons
Press to select channels. Use with Volume buttons to navigate in menus.

Volume Buttons
Press to adjust TV sound level. Use with Channel buttons to navigate in menus.

Action Button
Press to display Main Menu and access or exit On Screen feature and Adjustment Menus.

R-Tune (Rapid Tune) Button
Press to switch to the previous channel.

Recall Button
Press to display Time, status of Sleep Timer, Channel, Video Mode and Channel Caption (Station Identifier).

Keypad Buttons
Press desired channel number to randomly access any channel.

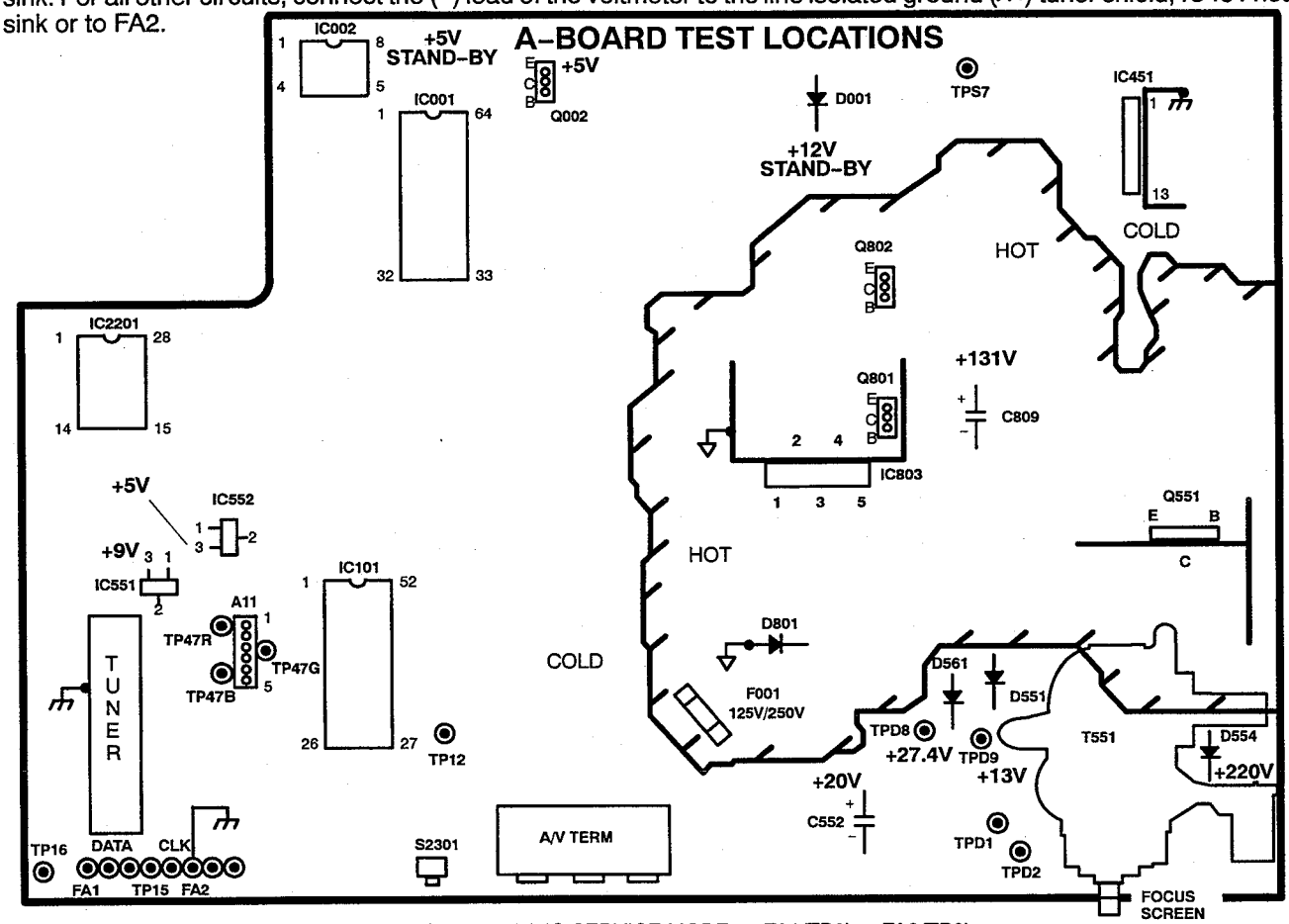
EUR511113
(SP2731W/UW)

Figure 3. **Location of controls (Receiver)**

Chassis Service Adjustment Procedures

All service adjustments are factory preset and should not require adjustments unless controls and/or associated components are replaced.

NOTE: Connect the (–) lead of the voltmeter to the appropriate ground for the circuit being checked. When necessary to use a line operated ground, the ground indication (⏚) is marked. For this ground use anode of D801 or IC803 heat sink. For all other circuits, connect the (–) lead of the voltmeter to the line isolated ground (⏚) tuner shield, IC451 heat sink or to FA2.



MOMENTARILY CONNECT A JUMPER FOR ENTERING SERVICE MODE -- FA1(TP8) to FA2(TP3)

131.0V B+ Voltage Confirmation

1. Set the **Bright** and the **Picture** to Minimum by using the Picture Menu.
2. Connect a DVM between C809, + side and Hot ground (⏚).
3. Confirm that B+ voltage is **131.0V±2.5VDC**. This voltage supplies B+ to the Horizontal Output & Flyback circuits.

Source Voltage Chart

120V AC line input. Set the **Bright** and the **Picture** to Minimum by using the Picture Menu . Use cold ground (⏚) for the (–) lead of the DVM.

IC551 pin 3 ..... **+9.0V ±0.5V**
Cathode of D551 (TPD9) ..... **+13.0V ±2V**
C552 (+ side) ..... **+20.0V ±2V**
Cathode of D561 (TPD8) ..... **+27.4V ±2V**
Cathode of D554 ..... **+220V ±15V**

Adjust Picture menu for normalized video adjustments.

B+ 5V Source Voltages

Volatile 5V:
C572, + side = IC552 pin 3, Tuner BP, IC101 (B+ V_{cc}).

MPU 5V:
Emitter Q002 = IC001(V_{DD}).

Standby 5V:
IC001 (Key in 1), I^2C EEPROM (IC002), TIMER LED, Remote Receiver.

B+ 9V Source Voltage

IC551 pin 3 = IC101 (B+ V_{cc}), Tuner (BM).

B+ 12V (Stand-by) Note: +16V when power is on

Cathode D001 = RL801 (on-off relay), Q002 (+5V Reg).

High Voltage Check

1. Select an active TV channel and confirm that horizontal is in sync.
2. Adjust Brightness and Picture using Picture Icon menu so video just disappears.
3. Confirm B+ 131V is within limit.
4. Using a high voltage meter confirm that the High Voltage is:
   - 27" models ..... **28.4kV ±1.25kV**

SERVICE

Disassembly for Service

Back Cover

Remove all the screws marked with an arrow (◄) from the back of the Receiver.

Note: screw configuration and number of screws may vary depending on the model of the Receiver serviced; various models are covered in this Manual.

1. 3 screws at the top edge of the Receiver.
2. 1 screw on the retainer plate for the AC power cord.
3. 1 screw by flyback assembly.
4. 1 screw by the A/V jacks.
5. 2 screws at the bottom edge of the Receiver.

A-Board – Main Chassis

1. Press tab on left rail.
2. Slide the chassis completely out of the guide rails. **NOTE:** Some tie-wraps that secure the wire dressings may need to be unfastened for chassis removal.
3. Stand the Receiver on its edge. The underside of the board is completely accessible for component replacement.

C-Board – CRT Output

Plugs into the socket on the CRT neck.

Y-Board – PIP Processing

Connected to the Main Chassis (A-Board). It is the board located close to the left edge of the A-Board. The Y-Board is connected to the A-Board with 2 connectors. Pull on the Y-Board, perpendicular to the A-Board, while releasing the snap tabs on connectors A31 & A32.

Keyboard Push Button Assembly

Fastened to the inside of the cabinet front by 3 screws.

Speakers

Secured to the cabinet by 2 screws each (20").
Secured to the cabinet by 4 screws each (27").

Disassembly for CRT Replacement

1. Discharge the CRT as instructed in the **Safety Precautions**.
2. Disconnect the yoke plug ,degaussing coil plug and the CRT 2nd anode button from the main board .
3. Remove the C-Board from the CRT base and unplug the black wire (CRT dag ground) C10-1 from the board.
4. Disconnect the A12 and SP plugs from the A-Board.
5. Slide the main chassis assembly completely out with the CRT Board attached.

CRT Replacement

1. Perform **Disassembly for CRT Replacement** procedure.
2. Insure that the CRT H.V. anode button is discharged before handling the CRT. See the **Safety Precautions** on handling the picture tube.
3. Remove the components from the CRT neck and place the cabinet face down on a soft pad.
4. Note the original order of the CRT mounting hardware as they are removed from the CRT mounting brackets at each corner of the CRT.
5. Remove the CRT with the degaussing coil and the dag ground braid attached.
6. Note the original locations and mounting of the degaussing coil and the dag ground assembly to insure proper reinstallation on the replacement CRT.

   To remove and re-mount the degaussing coil:
   The degaussing coil is held in place by clampers fastened to the CRT corner ears.
   These clampers must be installed onto the replacement CRT prior to mounting the degaussing coil.

   To remove and re-mount the dag ground braid:
   - Unhook the coil spring from the upper right CRT ear.
   - Release the braid loop from the upper left and the lower right CRT ear.
7. Mount the dag ground braid on the replacement CRT. Position the degaussing coil with new ties. Dress coil as was on the original CRT.
8. Replace the components on the CRT neck and re-install into cabinet. Verify that all ground wires and circuit board plugs get connected.

Purity and Convergence Procedure

Adjustment is necessary only if the CRT or the deflection yoke is replaced or if the setting was disturbed. The complete procedure consists of:

1. Initial static convergence.
2. Setting the purity.
3. Final static convergence.

When the CRT or the Yoke is Replaced

Place the yoke on the CRT neck (do not tighten the clamp).

For a 2-piece assembly (see Figure 4):

Position purity/convergence assembly as shown and tighten clamp snugly. Cut the hot-melt glue seal on assembly and place like tabs of purity device together at 12 o'clock to reduce its magnetic field effect. Manually degauss the CRT.

Turn the Receiver ON and slide the deflection yoke back and forth on the neck of the CRT. Stop at the position that produces a near white, uniform raster.

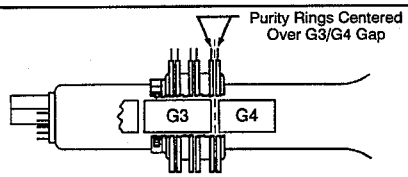


Figure 4. **Positioning of Purity/Convergence Assembly (2-piece assembly)**

For a 1-piece assembly (see Figure 5):

Place like tabs of purity devices together at 12 O'Clock to reduce any magnetic field effect. Manually degauss the set.

Connect a Black/White pattern generator and tune the receiver to the signal. Slide the deflection yoke & purity ring assembly back and forth on the CRT neck. Stop at a position that produces a near white signal.

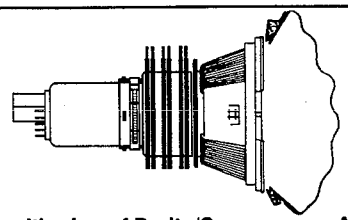


Figure 5. **Positioning of Purity/Convergence Assembly (1-piece assembly)**

Initial Center Static Convergence

Connect a dot/crosshatch generator to the Receiver and tune in signal. Observe misconvergence at center of the screen only.

Adjust the 4 pole magnet (center rings); separate tabs and rotate to converge blue with red.

Adjust the 6 pole magnet (rear rings): separate tabs and rotate to converge blue and red (magenta) with green.
Note: *Precise convergence at this point is not important.*

Purity Adjustment

When the Receiver is in the Serviceman Mode for making electronic adjustments, press the **Recall** button on the Remote Control to enter Purity Check. (See **Service Adjustments Electronic Controls**.)

Operate the Receiver for 60 minutes using the first Purity check field (white screen) to stabilize the CRT.

Fully degauss the Receiver by using an external degaussing coil.

Press the **Recall** button on the Remote Control again until the Purity Check (green screen) appears.

For a 2-piece assembly (see Figure 4):

Loosen the deflection yoke clamp screw and move the deflection yoke back as close to the purity magnet as possible.

Adjust the purity rings to set the vertical green raster precisely at the center of the screen (see Figure 6).

NOTES:
1. CRT warm up with white screen (three guns activated) is needed to stabilize the shadow mask expansion.
2. Initial center static convergence (roughly centers three gun beams) is required in order to perform purity adjustment.

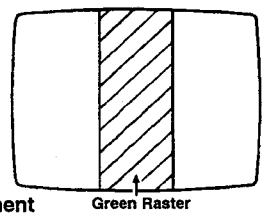


Figure 6. **Green Raster Adjustment**

Slowly move the deflection yoke forward until the best overall green screen is displayed.

For a 1-piece assembly (see Figure 5):

Slowly move the deflection yoke and purity rings assembly toward the CRT board and adjust the purity magnet rings to set vertical green raster at center of screen (see Figure 6).

Gradually move the deflection yoke & purity rings forward and adjust for the best overall green screen.

Continue from here for either assemblies:

Tighten the deflection yoke clamp screw.

Press the **Recall** button on the Remote Control again until the Purity Check (blue screen) and (red screen) appear and observe that good purity is obtained on each respective field.

Press the **Recall** button on the Remote Control again until Purity check (white screen) appears. Observe the screen for uniform white. If purity has not been achieved, repeat the above procedure.

Final Convergence Procedure (see Figure 7 through Figure 9):

Note: *Vertical size and focus adjustments must be completed prior to performing the convergence adjustment. Connect a dot pattern generator to the Receiver. The* ***Brightness*** *level should not be higher than necessary to obtain a clear pattern.*

Converge the red and blue dots at the center of the screen by rotating the 4 pole (R with B) Static Convergence Magnets.

Align the converged red/blue dots with the green dots at the center of the screen by rotating the 6 pole (R/B with G) Static Convergence Magnets. Melt wax with soldering iron to reseal the magnets.

SERVICE

Slightly tilt vertically and horizontally (do not rotate) the deflection yoke to obtain a good overall convergence.

If convergence is not reached at the edges, insert permalloy (see following section) from the DY corners to achieve proper convergence. Recheck for purity and readjust if necessary.

After vertical adjustment of the yoke, insert wedge at 11 o'clock position, then make the horizontal tilt adjustment.

Secure the deflection yoke by inserting two side wedges at 3 and 7 o'clock positions.

Apply adhesive between tab (thin portion) of wedge and CRT and place tape over the tab to secure to the CRT.

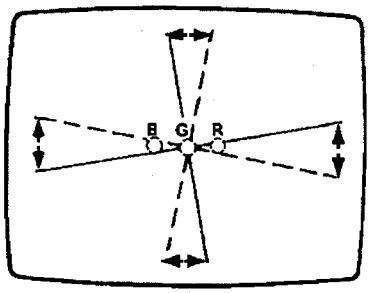
Permalloy Convergence Corrector Strip (Part No. OFMK014ZZ)

This strip is used in some sets to match the yoke and CRT for optimum convergence. If the yoke or CRT is replaced, the strip may not be required.

First converge the set without the strip and observe the corners.

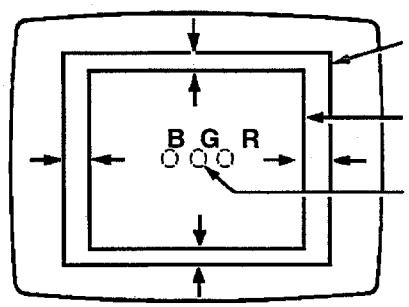
If correction is needed:

1. Place strip between CRT and yoke, in quadrant needing correction. Slowly move it around for desired results.
2. Press adhesive tightly to the CRT and secure with tape.



As the yoke is moved vertically, the rasters produced by the outside guns rotate in opposite directions.

Figure 7. **Vertical Yoke Movement**



Raster produced from one of the outside electron beams

Raster from the other outside electron beam

Static convergence magnets are set for center convergence

As the yoke is moved horizontally, one raster gets larger while the other gets smaller

Figure 8. **Horizontal Yoke Movement**

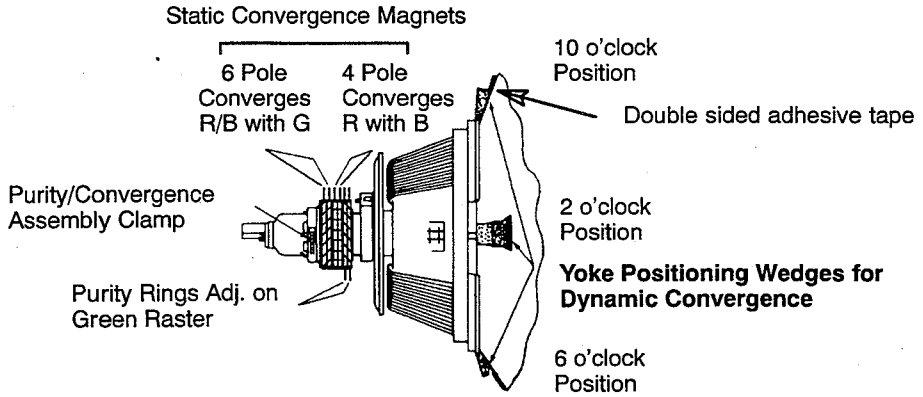

Static Convergence Magnets
6 Pole Converges R/B with G
4 Pole Converges R with B
10 o'clock Position
Double sided adhesive tape
Purity/Convergence Assembly Clamp
2 o'clock Position
Yoke Positioning Wedges for Dynamic Convergence
Purity Rings Adj. on Green Raster
6 o'clock Position

Figure 9. **Convergence Magnets and Wedges Location**

SERVICE

Serviceman Mode (Electronic Controls)

This Receiver has electronic technology using the I^2C Bus Concept. It performs as a control function and it replaces many mechanical controls. Instead of adjusting mechanical controls individually, many of the control functions are now performed by using the "On Screen Display Menu". (The **Serviceman Adjustment Mode**.)

Note: *It is suggested that the technician reads all the way through and understand the following procedure for Entering/Exiting the* ***Serviceman Adjustment Mode****; then proceed with the instructions working with the Receiver. When becoming familiar with the procedure, the Flow Chart for Serviceman Mode may be used as a quick guide.*

Quick Entry To Serviceman Mode:

At times when minor adjustments need to be done to the electronic controls, the method of Entering the Serviceman Mode without removal of the cabinet back is as follows using the Remote Control:

1. Select SET-UP icon and select CABLE mode.
2. Select TIMER Icon and set SLEEP timer for 30.
3. Press ACTION button twice to exit Menus.
   Tune to Channel 124.
   Adjust VOLUME to Minimum (0).
   On Receiver press the VOL ◄ button (decrease). Red "CHK" appears in upper corner.

To toggle between Aging and Serviceman modes:

While the "CHK" is displayed on the left top corner of the CRT, pressing the **Action** and the **Volume Down** buttons on the Receiver simultaneously will toggle between the modes. Red "CHK" for Serviceman and yellow "CHK" for Aging.

4. **Press** the **Power** button on the Remote Control to select one of five Serviceman Adjustment Modes.
   1) B = Serviceman VCJ SUB ADJUSTMENTS
   2) C = Serviceman VCJ CUT-OFF ADJUSTMENTS
   3) S = Serviceman OPTIONS (PIP and CLOCK) ADJUSTMENTS
   4) M = Serviceman MTS ADJUSTMENTS
   5) "CHK" = Normal operation of CHANNEL ▲▼ and VOLUME ◄►

Note: *Only the applicable settings for the Receiver serviced will be available (see a in Figure 10).*

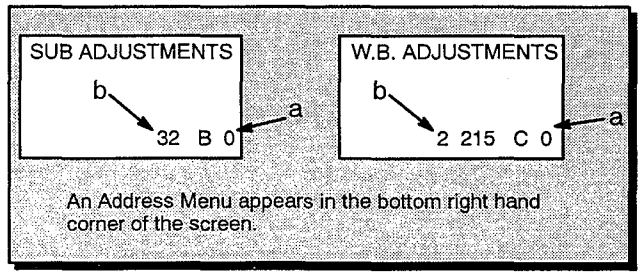


Figure 10. **Serviceman Mode Menu Adjustments**

For DAC Adjustments:

1. **Press**
   Channel Up/Down on the Remote Control to select one of the 8 available Service Adjustments (a in Figure 10).

   Important Note: *Write down the original value set (b in Figure 10) for each address before modifying anything. It is easy to erroneously adjust the wrong item.*

2. **Press**
   Volume Up/Down on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 10).

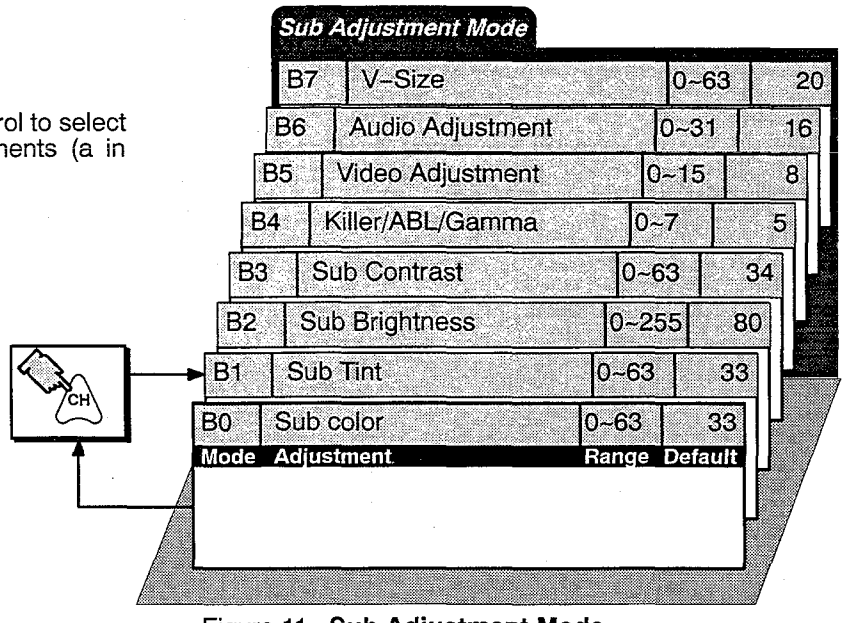

Sub Adjustment Mode
B7 V-Size 0~63 20
B6 Audio Adjustment 0~31 16
B5 Video Adjustment 0~15 8
B4 Killer/ABL/Gamma 0~7 5
B3 Sub Contrast 0~63 34
B2 Sub Brightness 0~255 80
B1 Sub Tint 0~63 33
B0 Sub color 0~63 33
Mode Adjustment Range Default
CH

Figure 11. **Sub Adjustment Mode**

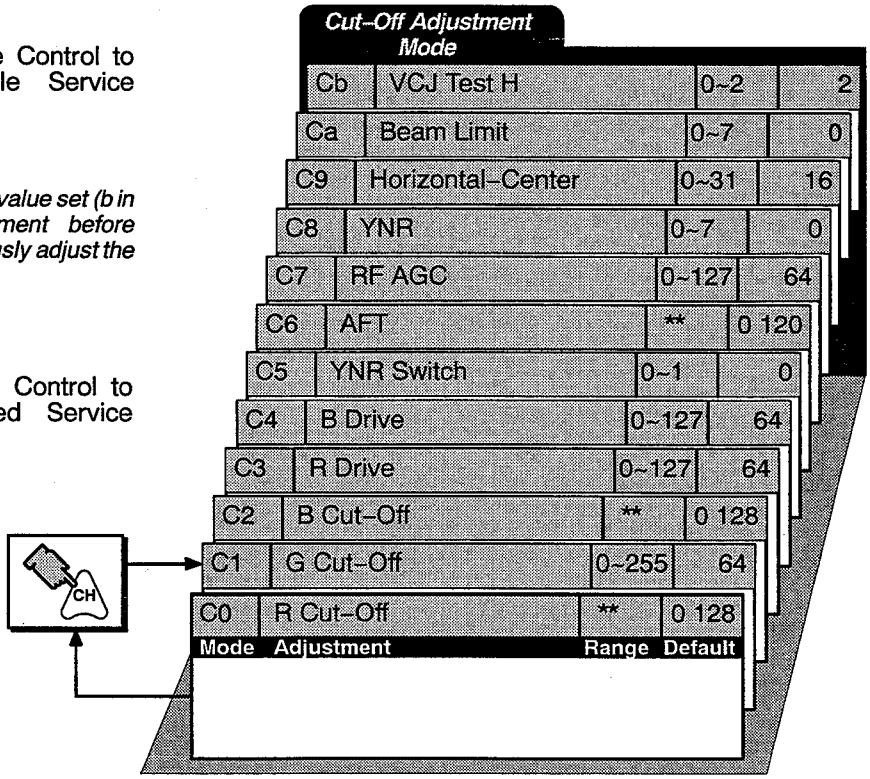
Press the **Power** button on the Remote Control to select the Serviceman White Balance Adjustment Mode.

For VCJ Cut-Off Adjustments:

1. **Press**
   Channel Up/Down on the Remote Control to select one of the 12 available Service Adjustments (a in Figure 10).

   Important Note: *Write down the original value set (b in Figure 10) for each address adjustment before modifying anything. It is easy to erroneously adjust the wrong item.*

2. **Press**
   Volume Up/Down on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 10).


Cut-Off Adjustment Mode
Cb VCJ Test H 0~2 2
Ca Beam Limit 0~7 0
C9 Horizontal-Center 0~31 16
C8 YNR 0~7 0
C7 RF AGC 0~127 64
C6 AFT ** 0 120
C5 YNR Switch 0~1 0
C4 B Drive 0~127 64
C3 R Drive 0~127 64
C2 B Cut-Off ** 0 128
C1 G Cut-Off 0~255 64
C0 R Cut-Off ** 0 128
Mode Adjustment Range Default
CH

*** Note:** *Range is in steps:*
0 0 ~ 0 255
1 0 ~ 1 255

Figure 12. **White Balance Adjustment Mode**

Press the **Power** button on the Remote Control to select the Serviceman MTS Adjustment Mode.

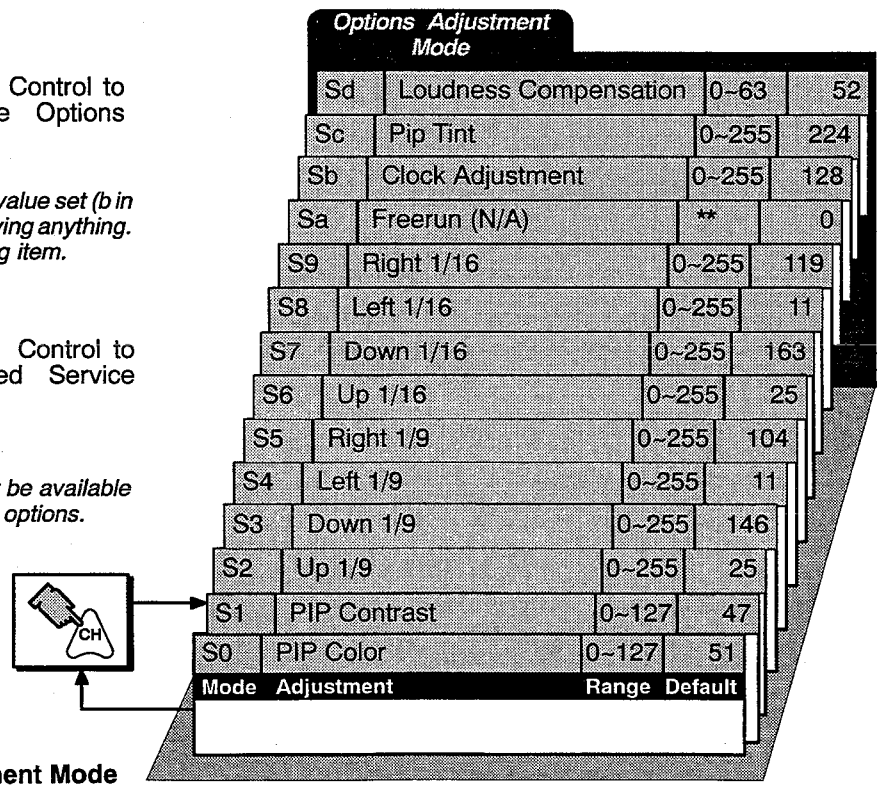
For Options (PIP and CLOCK) Adjustments:

1. **Press**
   Channel Up/Down on the Remote Control to select one of the 14 available Options Adjustments (a in Figure 10).

   Important Note: *Write down the original value set (b in Figure 10) for each address before modifying anything. It is easy to erroneously adjust the wrong item.*

2. **Press**
   Volume Up/Down on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 10).

   Note: *Some adjustment modes may not be available in some models depending on available options.*


Options Adjustment Mode
Sd Loudness Compensation 0~63 52
Sc Pip Tint 0~255 224
Sb Clock Adjustment 0~255 128
Sa Freerun (N/A) ** 0
S9 Right 1/16 0~255 119
S8 Left 1/16 0~255 11
S7 Down 1/16 0~255 163
S6 Up 1/16 0~255 25
S5 Right 1/9 0~255 104
S4 Left 1/9 0~255 11
S3 Down 1/9 0~255 146
S2 Up 1/9 0~255 25
S1 PIP Contrast 0~127 47
S0 PIP Color 0~127 51
Mode Adjustment Range Default
CH

** *Factory use only*

Figure 13. **Options Adjustment Mode**

SERVICE

Press the **Power** button on the Remote Control to select the Serviceman MTS Adjustment Mode.

For MTS Adjustments:

1. **Press**
   Channel Up/Down on the Remote Control to select one of the 5 available MTS Adjustments (a in Figure 10).

   Important Note: *Write down the original value set (b in Figure 10) for each address before modifying anything. It is easy to erroneously adjust the wrong item.*

2. **Press**
   Volume Up/Down on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 10).

3. Press the **POWER** button on the remote control to loop back to setting of the SUB ADJ Mode.

   OR

   Press **ACTION** and **POWER** buttons on the Receiver simultaneously for at least 2 seconds to return the Receiver to normal mode (exit Serviceman Mode).

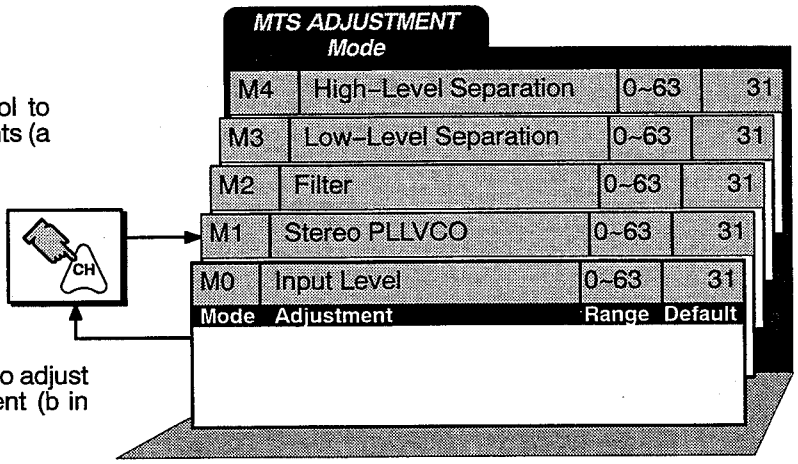


Figure 14. **MTS Adjustment Mode**

To Check Purity:

Press the **Recall** button on the Remote Control when in Serviceman Modes (red "CHK" is displayed) to enter the Purity Field Check Mode.

Note: *The Receiver must be in the Serviceman Mode to display color.*

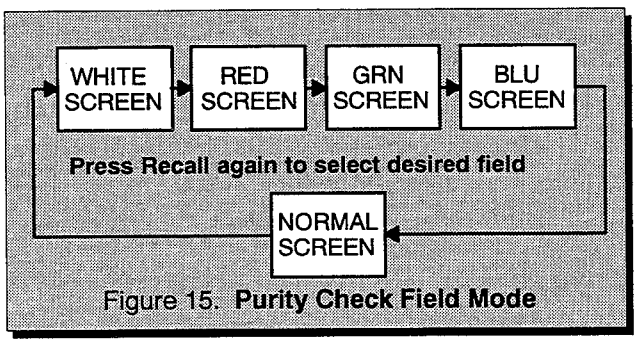


Figure 15. **Purity Check Field Mode**

IMPORTANT NOTE:
Always Exit the Serviceman Mode following Adjustments.

Exiting the Serviceman Mode:

Press the **Action** and the **Power** buttons on the Receiver simultaneously for at least 2 seconds.
"The Receiver exits Serviceman Mode".
The Receiver momentarily shuts off; then comes back on tuned to channel 3 with a preset level of sound.

Helpful Hints

Entering Serviceman Mode (Other Method – back open):

1. While the Receiver is ON and operating in Normal Mode, momentarily short test point FA1 to cold ground (⏚) FA2 (A–Board: TP pin 8 to pin 3).
   "The Receiver enters the Aging Mode".
   Yellow letters "CHK" appear in the upper left corner of the CRT.
   (The Volume Up/Down will adjust rapidly.)
2. Simultaneously **press** the **Action** and the **Volume Up** buttons on the Receiver Control Panel.
   "The Receiver enters the Serviceman's Mode".
   The letters in "CHK" turn red.
   (The Volume Up/Down will adjust normally.)
   (All customer controls are set to a nominal level.)

Instructional Flow Chart for Serviceman Mode

Caution: Always EXIT Serviceman Mode

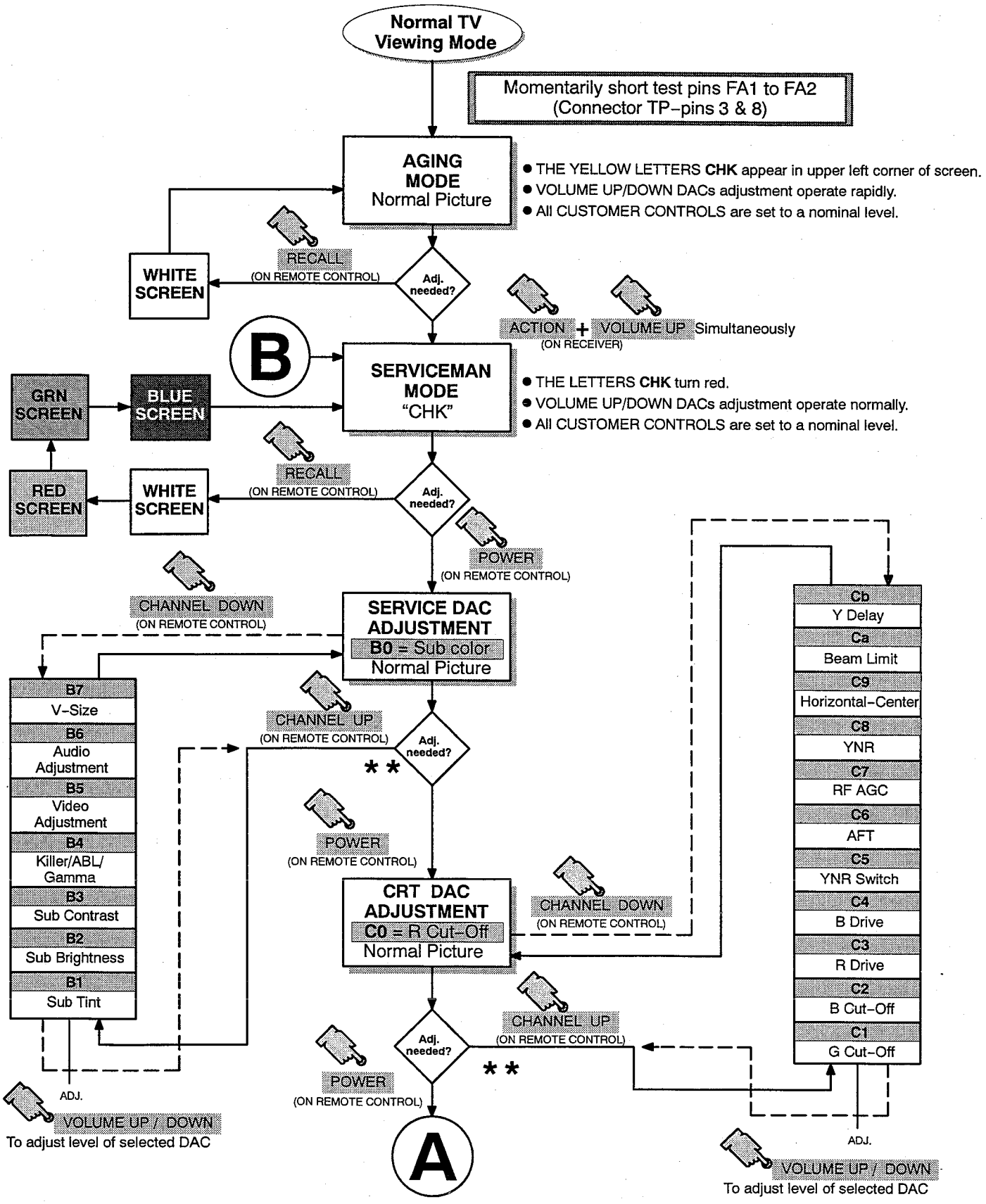


Figure 16. **Flow Chart for Serviceman Mode**

Instructional Flow Chart for Serviceman Mode – Continued

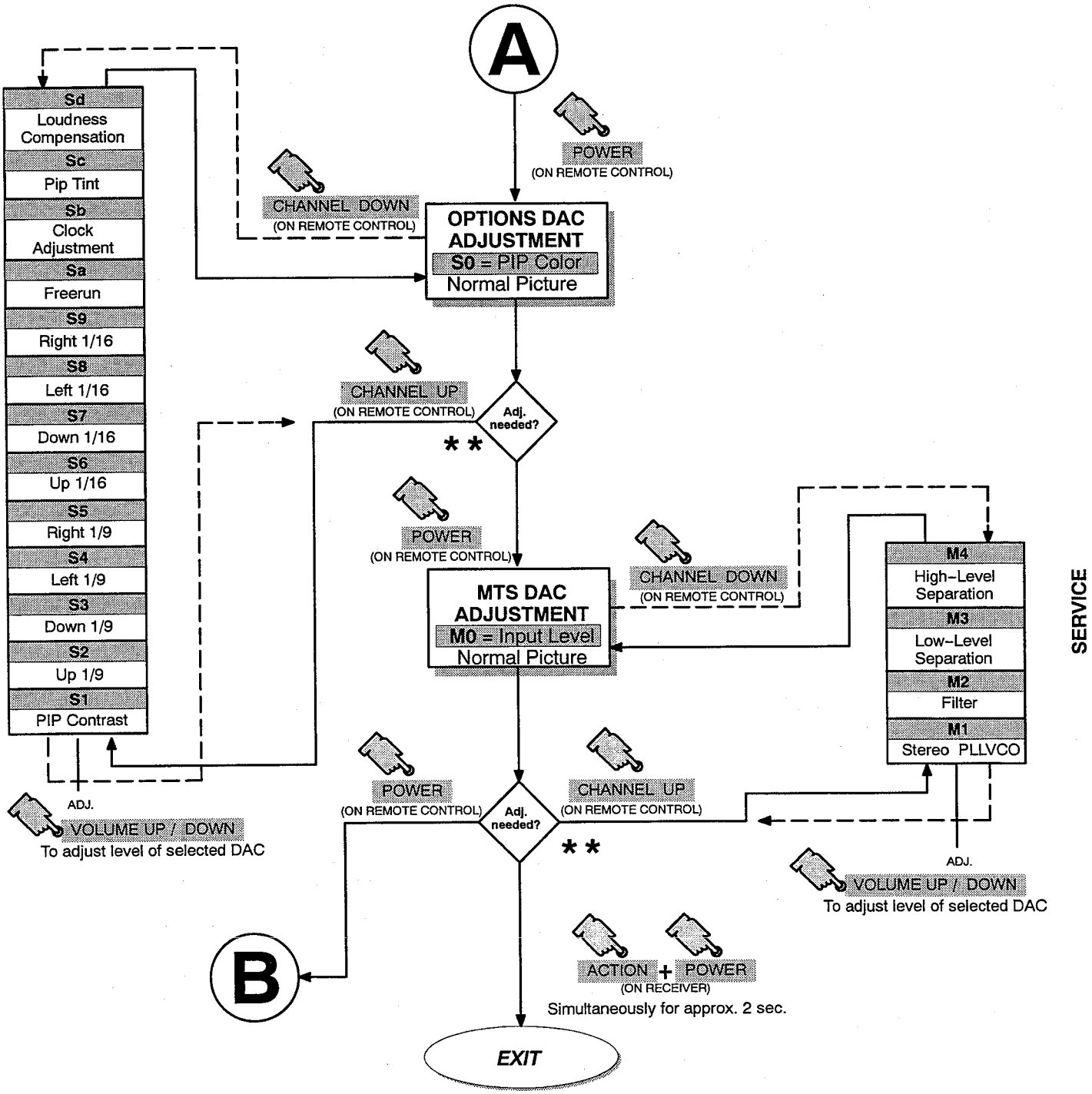


Figure 17. **Flow Chart for Serviceman Mode (Continued)**

Note: When *EXITING*, the Receiver shuts off, then turns on, TUNED TO CHANNEL 3 WITH A PRESET SOUND LEVEL.

Any Programmed Channels, Channels Caption data and some other user defined settings will be erased.

***Important Note**

Before making any DAC adjustments note the existing values!

SERVICE

Service Adjustments (Electronic Controls)

Video Adjustment Level

Serviceman DAC Adjustment (B5)

Preparation:

1. Obtain an NTSC color bar pattern with 100 IRE white and 87.5% modulation.
2. Connect the oscilloscope to TP12. Use cold ground for scope connection. Set the scope at Horizontal Sweep rate (20μs) time base.

Procedure:

1. In the Serviceman Mode for making electronic adjustments, select DAC Video Adjustment Level (B5) and adjust for 1.0V ±0.05V from sync tip to white level. See Figure 18.

Figure 18. **TP12 waveform**

2. Set the DAC Sub-Contrast Adjustment (B3).

Sub-Contrast

Serviceman DAC Adjustment (B3)

This adjustment is factory set. **Do not adjust** unless repairs are made to associated circuits, the CRT Board, or when the CRT is replaced.

Preparation:

1. Apply a color bar signal pattern with 87.5% modulation, 70% saturated color bar with a 100 IRE white and 7.5 black.

NOTE: The pattern used in this procedure is an EIA color bar pattern with 87.5% modulation with 100 IRE white and 7.5 black. Correlate the information in this procedure to the pattern used if another signal is used.

2. Preset the following controls:
   - Brightness ..... Center
   - Color ..... Min
   - Picture ..... Max.
   - Sharpness ..... Center
3. Connect the oscilloscope to the CRT-Board connector C1-2. Set the scope time base to 20μs (horizontal).
4. Connect a jumper from TPD2 to ground (⏚)
5. Connect a jumper from IC101 pin 28 to ground (⏚).

Procedure:

1. In the Serviceman Mode for electronic adjustments, select DAC Sub-Brightness Adjustment (B2) and adjust for 1.0-1.5Vp-p between blanking and 7.5 IRE level so that the black level cannot be compressed. (see video waveforms detail, Figure 19).
2. In the Serviceman Mode for electronic adjustments, select DAC Sub-Contrast Adjustment (B3) and adjust for 2.8Vp-p ±0.1V from white level to black level on video waveform (see video waveforms detail, Figure 19).

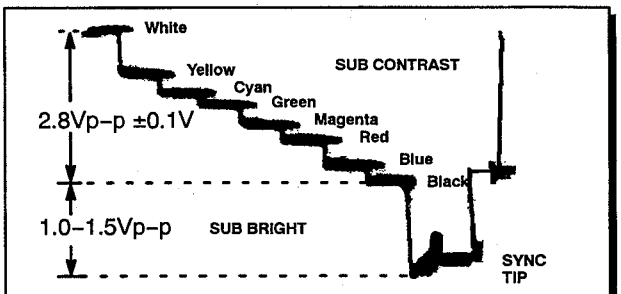


Figure 19. **TP35 waveform**

3. Remove the jumpers (Preparation steps 4 and 5).

Tint/Color Adjustment

Serviceman DAC Adjustment (B1) (B0)

Preparation:

1. Apply a rainbow color bar signal.
2. Preset the following controls:
   - Brightness ..... Min.
   - Color ..... Center
   - Picture ..... Max.
   - Sharpness ..... Min
   - Tint ..... Center
3. Connect the oscilloscope to TP47B (A-Board) or to connector C1 pin 3.
4. Connect a jumper from TPD2 to GND (⏚).
5. Connect a jumper from IC101 pin 28 to ground (⏚).

Procedure:

1. In the Serviceman Mode for making electronic adjustments, select DAC Sub-Tint Adjustment (B1). Adjust until the waveform measured is as the one shown in Figure 20.

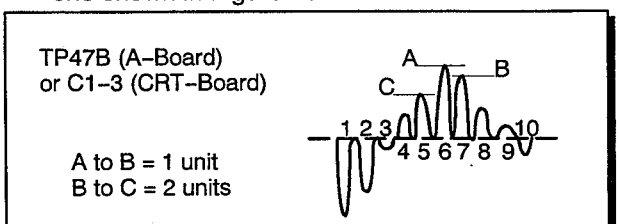


Figure 20. **TP47B waveform**

2. Connect the oscilloscope to TP47G (A-Board) or to connector C1 pin 2 (CRT-Board).
3. Select DAC Sub-Color Adjustment (B0) and adjust for peak to peak amplitude to be 0.8V p-p ±0.05V (Figure 21).

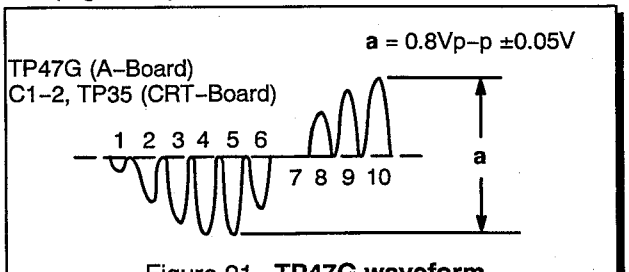


Figure 21. **TP47G waveform**

4. Remove the jumpers (Preparation steps 4 and 5).

SERVICE

Service Adjustments (Electronic Controls,cont.)

Color Temperature Adjustment (B/W Tracking)

Serviceman DAC Adjust. (C0) (C1) (C2) (C3) (C4)

Minor Touch-Up Method

OBSERVE low and high brightness areas of a B/W picture for proper tracking. Adjust only as required for "good grey scale and warm highlights".

1. LOW LIGHT areas - In Serviceman Mode for making electronic adjustments, select Cutoff (C0) RED, (C1) GRN, (C2) BLU and adjust the picture for grey.
2. HIGH LIGHT areas - In Serviceman Mode for making electronic adjustments, select Drive (C3) RED, (C4) BLU and adjust the picture for warm whites.

Complete Adjustment

Preparation:

1. Turn the Receiver "ON" and allow 10 minutes warm up at high brightness.
2. Apply a color bar signal with color "OFF".
3. Turn the SCREEN control (part of FBT T551) fully counterclockwise.

Procedure:

Preset the following Serviceman DAC's for the best results.

- C0 ..... 0 128
- C1 64
- C2 ..... 0 128
- C3 64
- C4 64

1. Connect the oscilloscope to C1-2 (CRT-Board).
2. In Serviceman Mode for making electronic adjustment, select the Sub-Bright DAC (B2).
3. Press the R-Tune key on the remote.
4. Observe the oscilloscope waveform at Horizontal rate and adjust the Serviceman Mode Sub-Bright DAC (B2) level until a scanning period of 3.0V above DC ground is measured, as indicated in Figure 22.

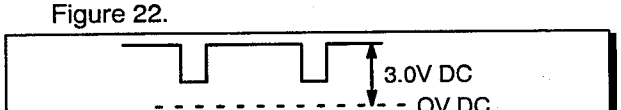


Figure 22. **TP35 waveform**

5. Connect the scope to GRN Cathode (KG) on the CRT-Board.
6. In the Serviceman Mode for making electronic adjustments, select the GREEN CUTOFF DAC (C1).
7. Press the R-Tune key on the remote.
8. View scope trace at Horizontal rate and adjust the Serviceman Mode DAC (C1) level until a scanning period of 195V above DC ground is measured, as indicated in Figure 23.

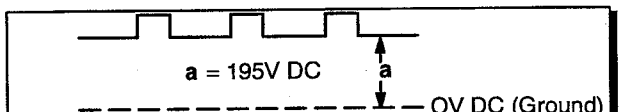


Figure 23. **Cathode waveform, Adjustment Waveform Detail (Steps 8, 12 & 16)**

9. Connect the scope to the RED Cathode (KR).
10. In Serviceman Mode for making electronic adjustments, select the RED CUTOFF DAC (C0).
11. Press the R-Tune key on the remote.
12. View the scope trace and adjust the Serviceman Mode DAC (C0) for the scanning period to be 195V above DC ground. (See Figure 23)
13. Connect the scope to the BLU Cathode (KB).
14. In Serviceman Mode for making electronic adjustments, select the BLU CUTOFF (C2).
15. Press the R-Tune key on the remote.
16. View the scope trace and adjust the Serviceman Mode DAC (C2) for the scanning period to be 195V above DC ground. (See Figure 23)
17. Turn the Screen Control (part of FBT) slowly clockwise until a color horizontal line appears.
18. With the other two colors Serviceman Mode DAC CUTOFF adjustments (C0) RED, (C1) GRN, (C2) BLU; increase the colors to create a white horizontal line.
19. Confirm that a good gray scale is established by viewing B/W color bar pattern.
20. In the Serviceman Mode for making electronic adjustments select the DAC DRIVE adjustments (C3) RED, (C4) BLU and adjust for warm white in a white color bar pattern.
25. EXIT the Serviceman Mode.
26. Adjust the Picture Menu Video Adjustments **Bright** and **Picture** from low scale to high scale and check Black and White tracking.
27. If correction is needed: Re-Enter the Serviceman Mode and perform the **Minor Touch - Up Method.**
28. Perform **Sub-Brightness** Adjustment procedure.

Sub-Brightness

Serviceman DAC Adjustment (B2)

Adjustment of this control is important for setting proper operation of customer brightness and picture controls. This adjustment must be made after Sub-Contrast or Color Temperature adjustments are made. **Do not adjust** SCREEN after the Sub-Brightness is set.

Preparation:

1. Apply a color bar signal with 100 IRE white and 7.5 IRE black. (Switch Color to "OFF" on the signal generator.) Operate the Receiver for a minimum of 10 minutes prior to performing this adjustment.
2. Preset the following controls:
   - Color ..... Center
   - Picture ..... Max.
   - Tint ..... Center

Procedure:

In the Serviceman Mode for making electronic adjustments, select the DAC adjustment (B2) and adjust until the black bar starts to look grey. Then decrease the level to the point where grey turns to black.

SERVICE

Service Adjustments (Electronic Controls,cont.)

Horizontal Centering

Serviceman DAC Adjustment (C9)

Preparation:

Connect a crosshatch generator.

Procedure:

1. In the Serviceman Mode for making electronic adjustments. Select the Horizontal Centering Adjustment DAC (C9) and adjust until the center of the crosshatch pattern is centered on CRT.
2. EXIT the Serviceman Adjustment Mode.

Audio Adjustment

Serviceman DAC Adjustment (B6)

This adjustment is factory set and needs to be performed only when IC002 or IC101 is replaced.

Preparation:

1. Apply the following signal at the antenna (70dB ±5dB, 75Ω open P/S 10dB): audio signal set to monaural, 300Hz. 100% modulation; video input of 100 IRE flat field, 30% modulation.
2. Connect the RMS Meter with filter jig as shown in Figure 24.

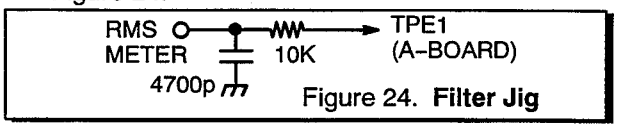


Figure 24. **Filter Jig**

Procedure:

1. In the Serviceman Mode for making electronic adjustments, select the Audio Adjustment DAC (B6) and adjust until the RMS meter reading are:
   150mV RMS ±7.5mV RMS (Stereo models)
   250mV RMS ±12.5mV RMS (Mono models)
2. EXIT the Serviceman Adjustment Mode.

Clock Adjustment (Sb)

Preparation:

Connect the frequency counter from TPS1 (IC001 Pin 13) to cold ground (⏚).

NOTE: Frequency Counter probe capacitance should be 8pF or less.

Procedure:

1. Turn the Receiver "OFF" with the AC power applied.
2. Measure TPS1 (IC001 pin 13) for the frequency of the waveform and record the reading.

   Note: Pin 13 measurement must have at least four digits of resolution following the decimal point Example: 000.0000
3. Turn the Receiver "ON".
4. Place the Receiver into Serviceman Mode for making electronic adjustment, select the Clock Adjustment DAC (Sb).
5. Calculate and set Sb based on the following formula:

$$Sb = 128 + 0.901 \times 10^6 \times \frac{\{244.1406 - \text{pin 13 [Hz]}\}}{244.1406}$$

NOTE: Pin 13 measurement will not change regardless of the value stored in Sb.

Vertical Size (B7)

1. Adjust the VERTICAL SIZE DAC control, B7, until the top and the bottom edges of the raster are visible.
2. Adjust the VERTICAL SIZE control B7, until the top and the bottom of the raster touch the bezel edge. Then advance SIZE control to obtain an approximately 10% overscan. Linearity adjustment is done automatically when the size is being adjusted. (Best results can be obtained with a round test pattern.)

SERVICE

Service Adjustments (Mechanical Controls)

VCO Field Alignment L105

1. Connect a balance antenna and select a midband channel (Ch 10, 11 or 12)
2. Attenuate the signal strength for a weak noisy video.
3. While observing the picture tube, adjust L105 until best picture appears.
4. Change channels and observe that they are tuning properly.
5. If the channel monitored is not clear, repeat steps 1, 3 and 4 while applying a stronger signal.

Focus (Part of T551)

Preparation:

Connect a Signal generator and select a dot pattern.

Procedure:

Adjust the FOCUS control to obtain the sharpest and clearest dot pattern.

a. adjust for best center.
b. adjust for best area between the center and top right corner.

Audio Signal Path Block Diagram
(CT-27G23W/UW/CW)

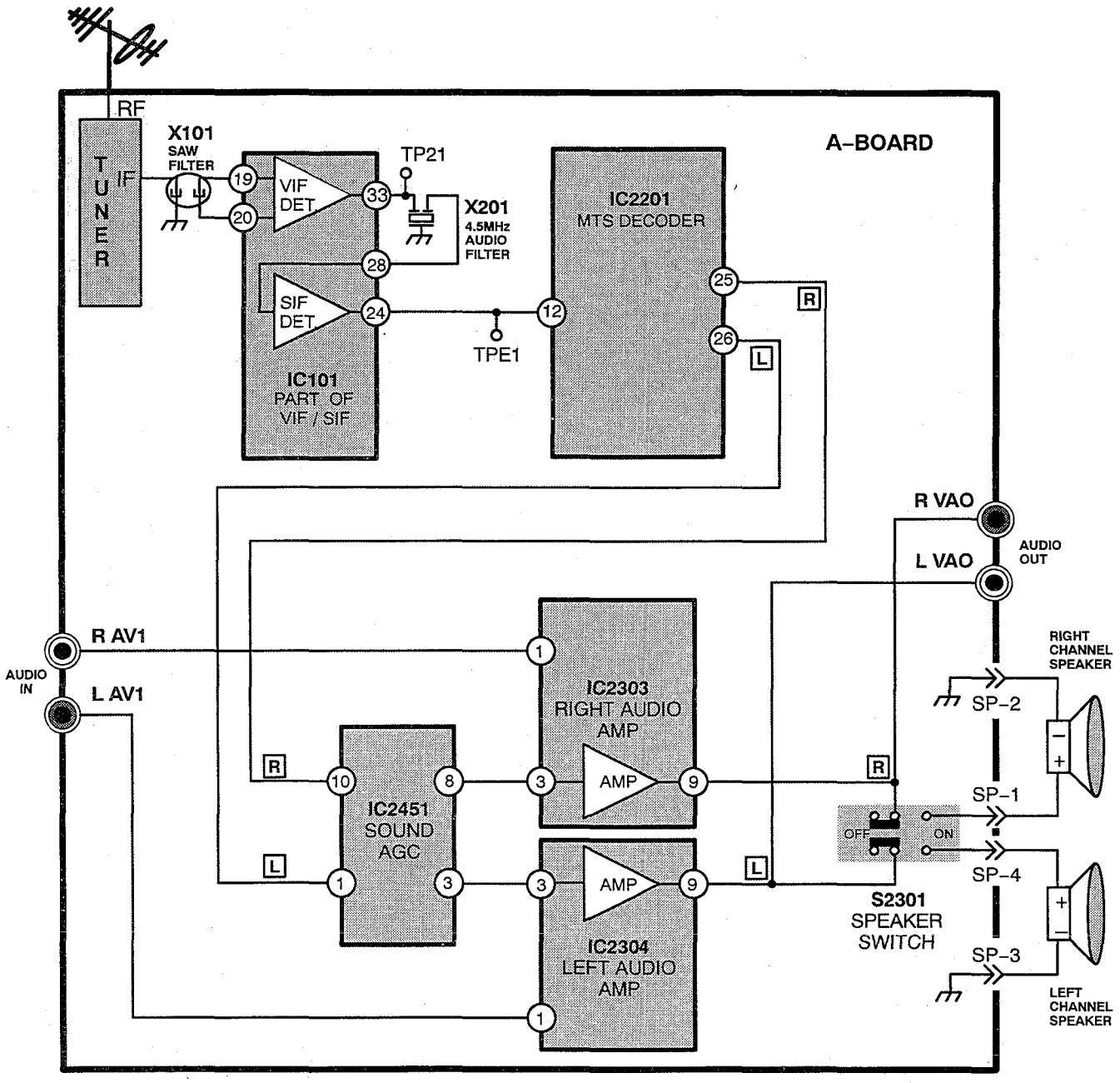
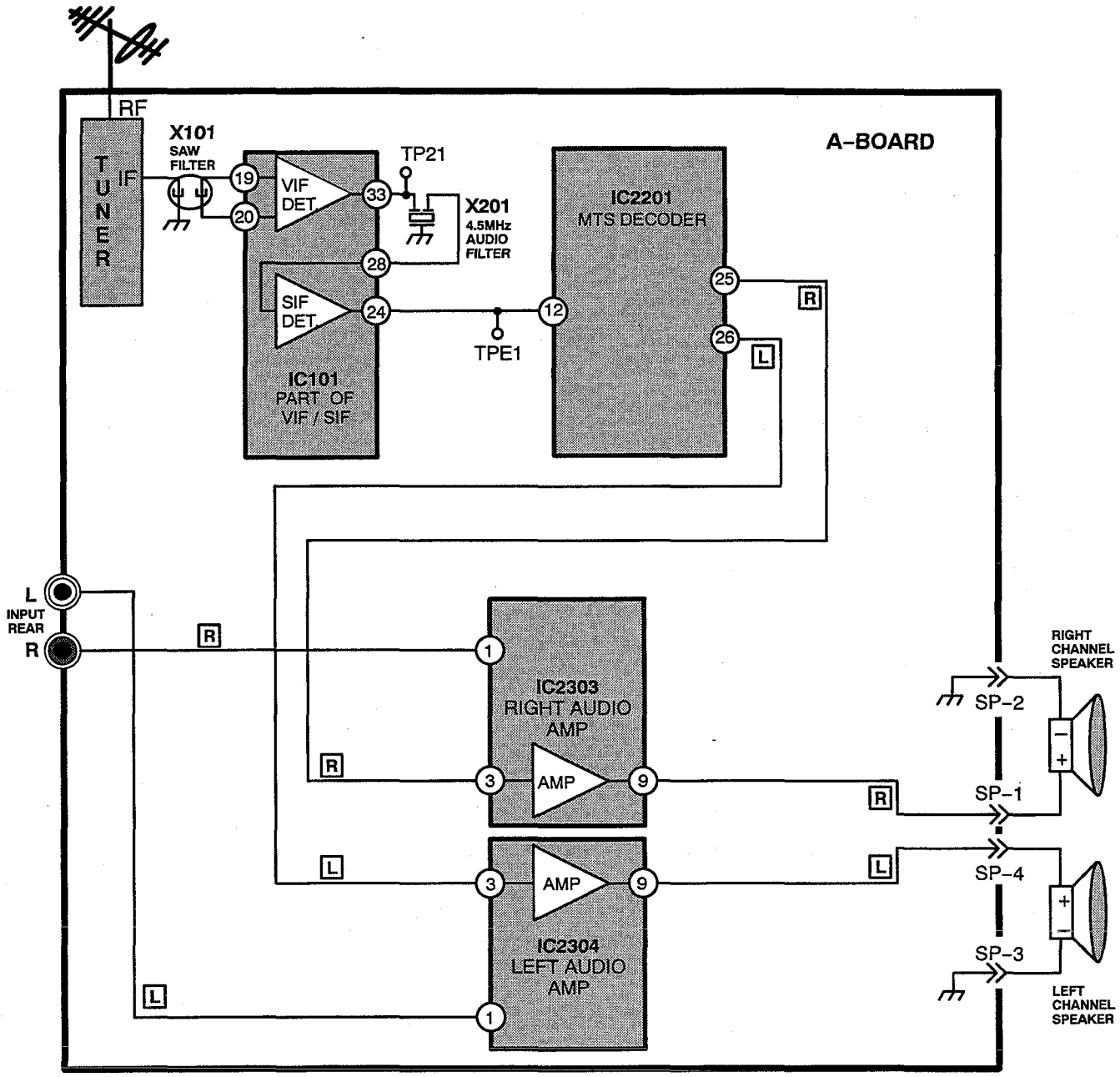


Figure 25. **Audio Signal Path Block Diagram**

Audio Signal Path Block Diagram

(SP2731W/UW only)



CIRCUITS & BLOCK DIAGRAMS

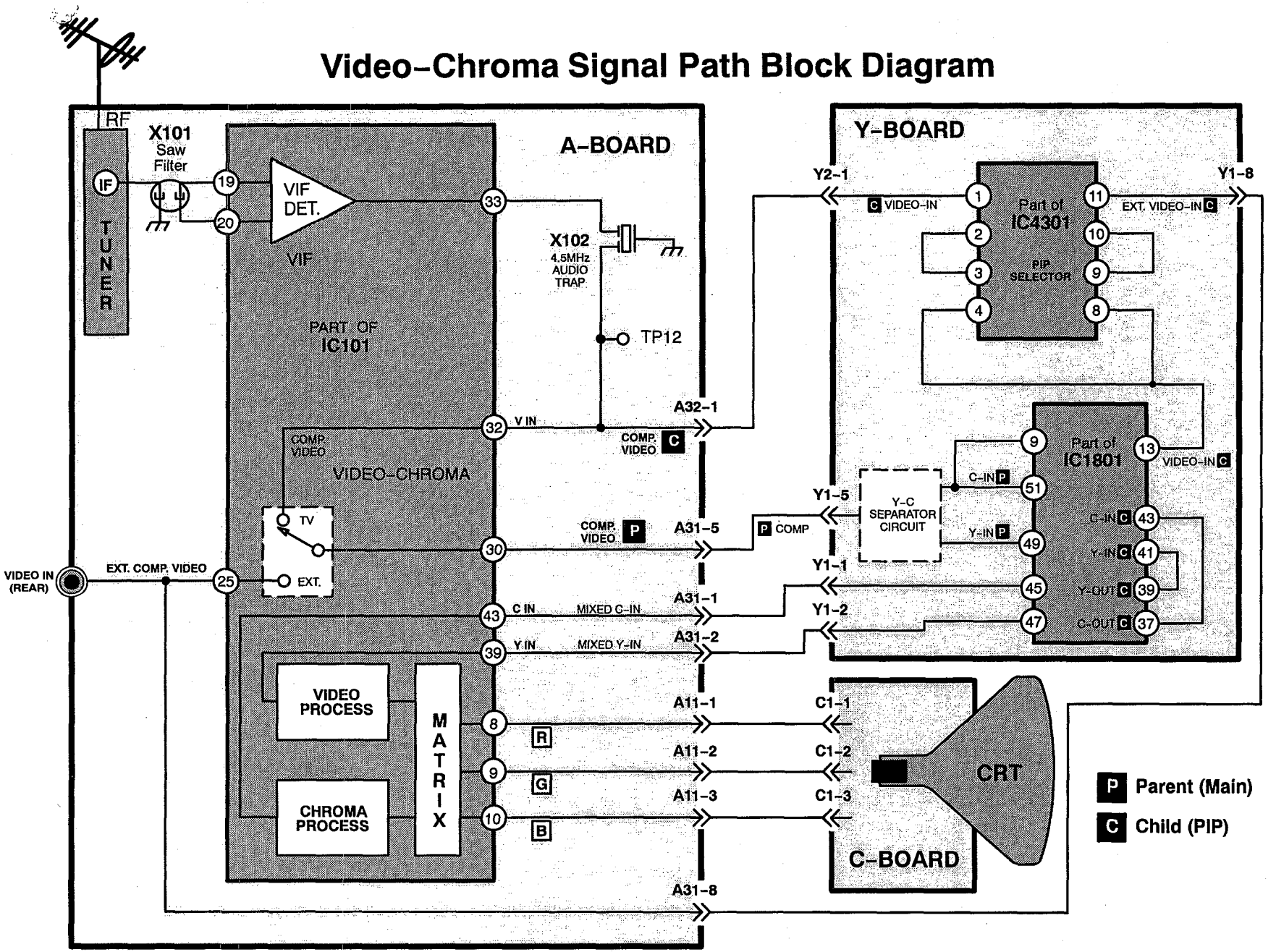
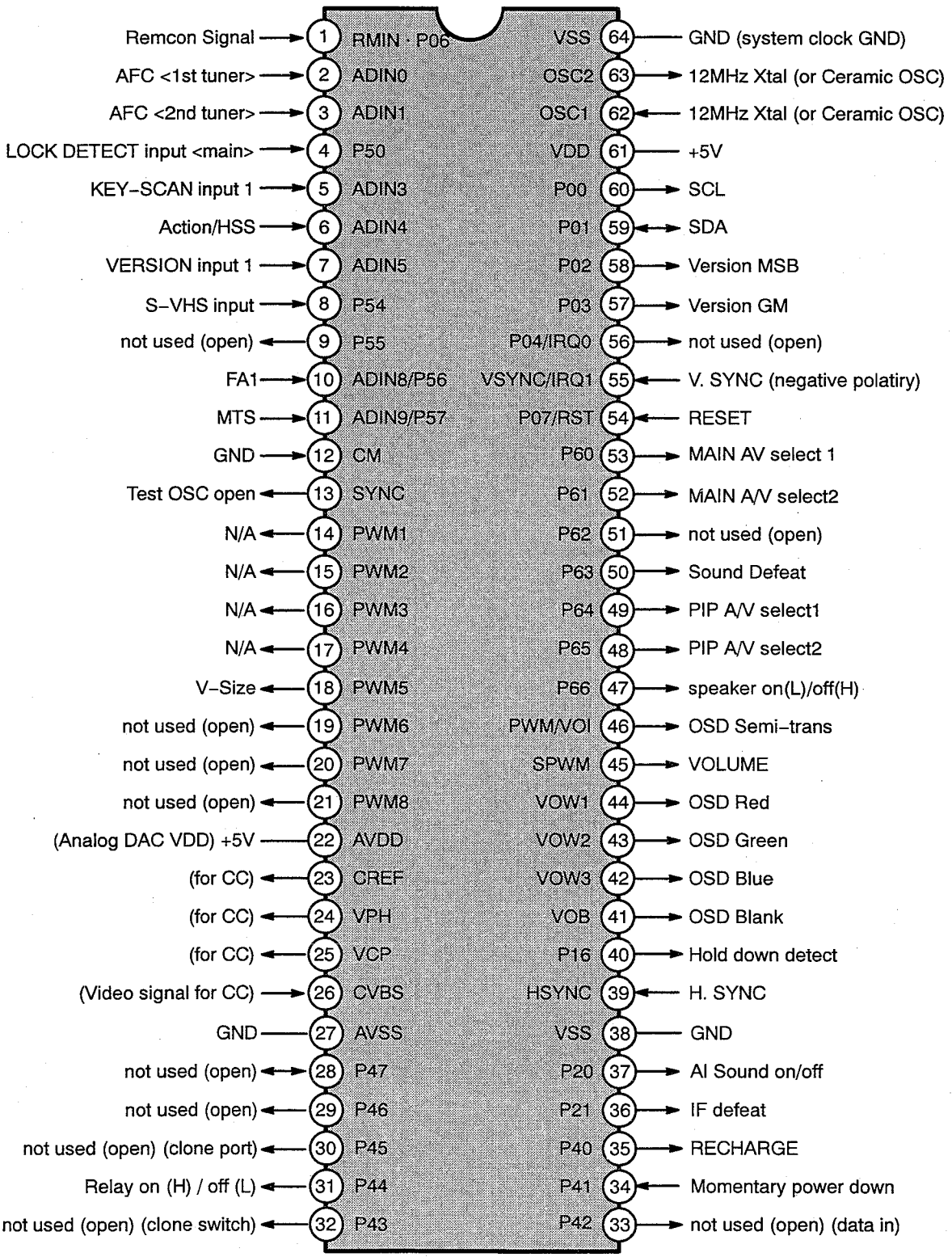


Figure 26. **Video-Chroma Signal Path Block Diagram**

IC001 MPU IN/OUT Pins and Functions
MN1874085TJW



IC101 Block Diagram

INPUT PINS = ◁ ▷ OUTPUT PINS = ◀ ▶

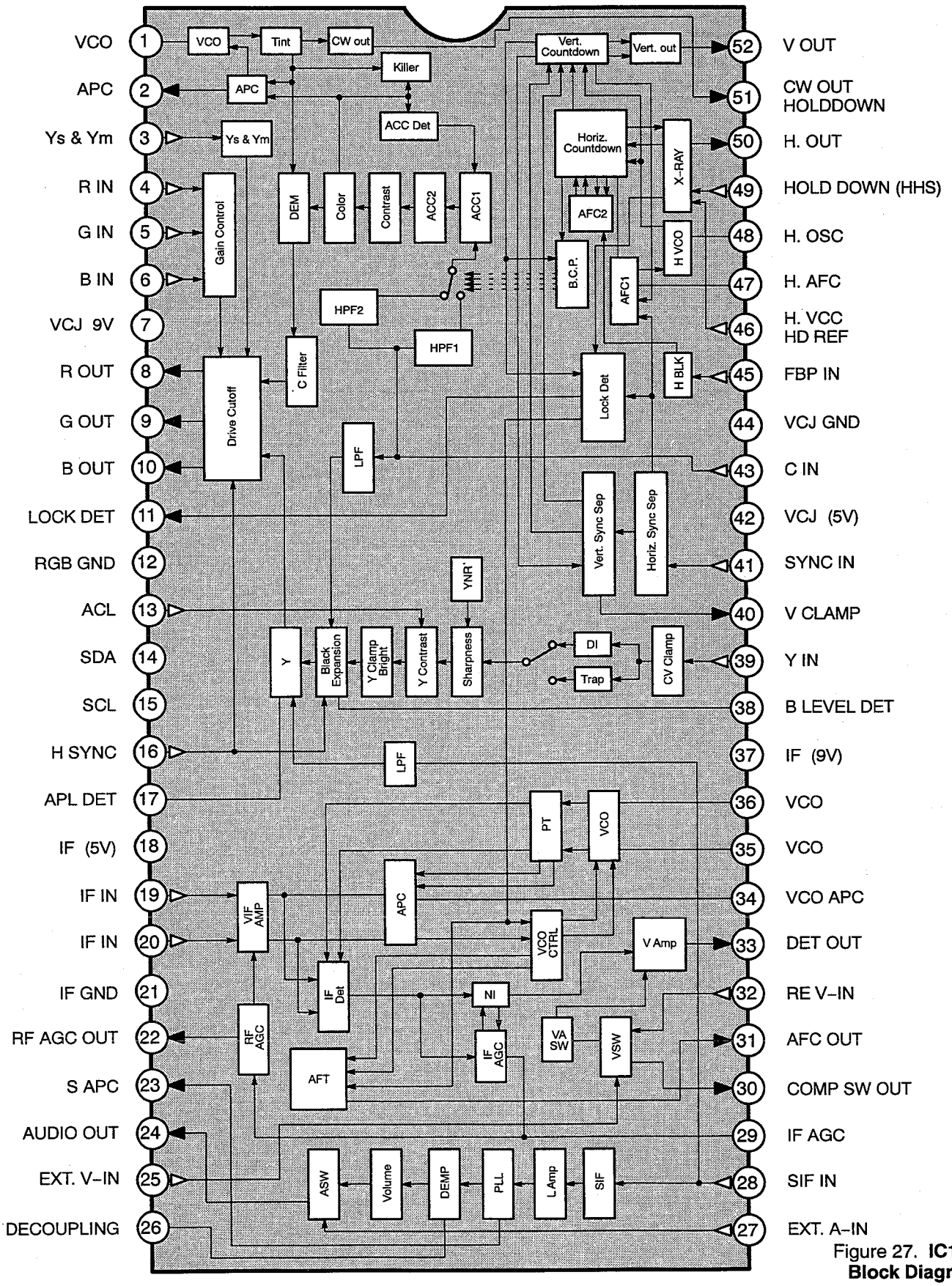


Figure 27. **IC101 – Block Diagram**

REPLACEMENT PARTS LIST

(Models: CT-27G23W/CW/UW & SP2731W/UW)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
	CAPRISTORS	
CRA801	**EXNG471P365**	**RES-CAP 470PF/3.6 MEG**
CRA802	**EXNG471P365**	**RES-CAP 470PF/3.6 MEG**
	CAPACITORS	
C001	ECA1AM101	CAP,E 100UF/10V
C003	ECA1HM4R7	CAP,E 4.7UF/50V
C004	ECUX1H330JCX	CAP,C 33PF-J-50V
C005	ECUX1H330JCX	CAP,C 33PF-J-50V
C008	ECUX1H104ZFX	CAP,C .1UF-Z-50V
C010	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C011	ECA1CM221	CAP,E 220UF/16V
C013	ECA0JM101	CAP,E 100UF/6.3V
C016	ECUX1H101JCX	CAP,C 100PF-J-50V
C017	ECUX1H220JCX	CAP,C 22PF-J-50V
C018	ECUX1H220JCX	CAP,C 22PF-J-50V
C019	ECA0JM101	CAP,E 100UF/6.3V
C020	ECA0JM101	CAP,E 100UF/6.3V
C022	ECA1CM471	CAP,E 470UF/16V
C024	ECA1EM4R7	CAP,E 4.7UF/25V
C025	ECUX1H101JCX	CAP,C 100PF-J-50V
C026	ECA1HM010	CAP,E 1.0UF/50V
C031	ECUX1H821KBX	CAP,C 820PF-K-50V
C032	ECA1AM470	CAP,E 47UF/10V
C035	ECUX1H220JCX	CAP,C 22PF-J-50V
C036	ECUX1H220JCX	CAP,C 22PF-J-50V
C037	ECUX1H220JCX	CAP,C 22PF-J-50V
C038	ECUX1H220JCX	CAP,C 22PF-J-50V
C101	ECUX1H223ZFX	CAP,C .022UF-Z-50V
C102	ECA1EM100	CAP,E 10UF/25V
C103	ECUX1H300JCX	CAP,C 30PF-J-50V
C105	ECUX1H221JCX	CAP,C 220PF-J-50V
C106	ECA1HMR47	CAP,E .47UF/50V
C107	ECUX1H470JCX	CAP,C 47PF-J-50V
C108	ECA1HMR22	CAP,E .22UF/50V
C109	ECEA1HN4R7U	CAP,E 4.7UF/50V
C110	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C111	ECA1EM100	CAP,E 10UF/25V
C113	ECA1EM100	CAP,E 10UF/25V
C117	ECUX1H070DCX	CAP,C 7PF-D-50V
C151	ECA1HMR22	CAP,E .22UF/50V
C201	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C202	ECUX1H101JCX	CAP,C 100PF-J-50V
C203	ECA1EM4R7	CAP,E 4.7UF/25V
C301	ECUX1H390JCX	CAP,C 39PF-J-50V
C302	ECEA1HN010U	CAP,E 1UF/50V
C304	ECEA1HNR47U	CAP,E .47UF-50V
C305	ECA1EM4R7	CAP,E 4.7UF/25V
C306	ECA1CM221	CAP,E 220UF/16V
C308	ECQB1H823JF	CAP,P .082UF-J-50V
C309	ECA1AM101	CAP,E 100UF/10V
C310	ECA1EM4R7	CAP,E 4.7UF/25V
C311	ECA1EM4R7	CAP,E 4.7UF/25V
C312	ECA1EM220	CAP,E 22UF/25V
C314	ECUX1H104ZFX	CAP,C .1UF-Z-50V
C315	ECUX1H680JCX	CAP,C 68PF-J-50V
C351	TACCW391T50V	CAP,C 390PF/50V

REF. NO.	PART NO.	DESCRIPTION
C352	TACCW391T50V	CAP,C 390PF/50V
C353	TACCW471T50V	CAP,C 470PF/50V
C354	ECKD3D102KB	CAP,C .001UF-K-2KV
C357	ECEA1HN010U	CAP,E 1UF/50V
C401	ECQB1H153JF	CAP,P .015UF-J-50V
C402	ECUX1H471KBX	CAP,C 470PF-K-50V
C403	ECA1HM2R2	CAP,E 2.2UF/50V
C451	ECA1AM470	CAP,E 47UF/10V
C452	ECSF1EE105	CAP,T 1.0UF/25V
C453	ECEA1HFS010	CAP,E 1UF/50V
C454	ECA1EM102	CAP,E 1000UF/25V
C455	ECA1VHG101B	CAP,E 100UF-35V
C456	ECQB1H103JF	CAP,P .01UF-J-50V
C459	ECA1VM471	CAP,E 470UF/35V
C460	ECQM1104JZ	CAP,P .1UF-J-100V
C462	ECA1EM100	CAP,E 10UF/25V
C502	ECQB1H223JF	CAP,P .022UF-J-50V
C503	ECA1HM2R2	CAP,E 2.2UF/50V
C504	ECUX1H101JCX	CAP,C 100PF-J-50V
C505	ECUX1H221JUX	CAP,C 220PF-J-50V
C506	ECA1CM221	CAP,E 220UF/16V
C507	ECUX1H331JCX	CAP,C 330PF-J-50V
C508	ECUX1H121JCX	CAP,C 120PF-J-50V
C510	ECCD2H100D	CAP,C 10PF-D-500V
C511	ECKD2H821KB	CAP,C 820PF-K-500V
C512	ECKD2H101KB	CAP,C 100PF-K-500V
C531	**ECA1EM220**	**CAP,E 22UF/25V**
C532	ECA1AM102	CAP,E 1000UF/10V
C533	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C534	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C551	**ECA1VM331**	**CAP,E 330UF/35V**
C552	**ECA1EM471**	**CAP,E 470UF/25V**
C553	ECKD2H561KB	CAP,C 560PF-K-500V
C554	ECKD2H561KB	CAP,C 560PF-K-500V
C555	**ECEA2EU220**	**CAP,E 22UF/250V**
C556	**ECA1CM471**	**CAP,E 470UF/16V**
C557	ECKD2H102KB	CAP,C .001UF-K-500V
C558	ECA1CM221	CAP,E 220UF/16V
C559	ECA1HM220	CAP,E 22UF/50V
C560	**ECEA1HN2R2U**	**CAP,E 2.2UF/50V**
C561	ECKD2H561KB	CAP,C 560PF-K-500V
C562	ECKD2H561KB	CAP,C 560PF-K-500V
C563	**ECWH12H822JS**	**CAP,P .0082UF-J-1.2KV**
C564	**ECWH12H332JS**	**CAP,P .0033UF-J-1.2KV**
C565	**ECKD3D331JB**	**CAP,C 330PF-J-2KV**
C566	**ECKD3D181JB**	**CAP,C 180PF-J-2KV**
C568	**ECQM2274JZ**	**CAP,P .27UF-J-200V**
C569	**ECWF2474JBB**	**CAP,P .47UF-J-200V**
C571	ECA1EM220	CAP,E 22UF/25V
C572	ECA1EM100	CAP,E 10UF/25V
C573	ECA1CM101	CAP,E 100UF/16V
C601	ECUX1H181JCX	CAP,C 180PF-J-50V
C602	ECUX1H680JCX	CAP,C 68PF-J-50V
C604	ECUX1H150JUX	CAP,C 15PF-J-50V
C605	ECUX1H332KBX	CAP,C .0033UF-K-50V
C606	ECA1HM010	CAP,E 1.0UF/50V

REPLACEMENT PARTS LIST

(Models: CT-27G23W/CW/UW & SP2731W/UW)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
C801	**ECKD2H472PU**	**CAP,C .0047UF-P-500V**
C802	**ECKD2H472PU**	**CAP,C .0047UF-P-500V**
C805	**EC0S2DA221BB**	**CAP,E 220UF/200V**
C806	**EC0S2DA221BB**	**CAP,E 220UF/200V**
C807	ECA1HM3R3	CAP,E 3.3UF/50V
C808	ECA1CM101	CAP,E 100UF/16V
C809	**EC0S2DG151DG**	**CAP,E 151UF/200V**
C810	**ECQU2A153MV**	**CAP,P .015UF-M-250V**
C811	**ECQU2A153MV**	**CAP,P .015UF-M-250V**
C812	**ECQU2A224MV**	**CAP,P .22UF-M-250V**
C814	ECQB1H333JF	CAP,P .033UF-J-50V
C815	ECA1EHG101B	CAP,E 100UF-25V
C818	ECKD3A821KB	CAP,C 820PF-K-1KVDC
C820	**ECA1JHG100B**	**CAP,E 10UF-63V**
C823	**ECEA160V33Z**	**CAP,E 33UF/160V**
C824	ECKD3A331KB	CAP,C 330PF-K-1KVDC
C825	ECKD3A471KB	CAP,C 470PF-K-1KV
C1801	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1802	ECQB1H154JF	CAP,P .15UF-J-50V
C1803	ECA1HMR22	CAP,E .22UF/50V
C1804	ECEA1HKAR22	CAP,E .22UF/50V
C1805	ECUX1H333ZFX	CAP,C .033UF-Z-50V
C1806	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1807	ECA1CM470	CAP,E 47UF/16V
C1808	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1809	ECA1CM470	CAP,E 47UF/16V
C1810	ECUX1H104ZFX	CAP,C .1UF-Z-50V
C1811	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1812	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1813	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1815	ECUX1H104ZFX	CAP,C .1UF-Z-50V
C1816	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1817	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1818	ECA1CM100	CAP,E 10UF/16V
C1819	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1820	ECA1CM470	CAP,E 47UF/16V
C1821	ECUX1H150JCX	CAP,C 15PF-J-50V
C1822	ECUX1H120JCX	CAP,C 12PF-J-50V
C1823	ECUX1H680JCX	CAP,C 68PF-J-50V
C1826	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1827	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1828	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C1829	ECUX1H104ZFX	CAP,C .1UF-Z-50V
C1830	ECUX1H560JCX	CAP,C 56PF-J-50V
C1831	ECUX1H104ZFX	CAP,C .1UF-Z-50V
C1832	ECUX1H104ZFX	CAP,C .1UF-Z-50V
C1833	ECUX1H104ZFX	CAP,C .1UF-Z-50V
C1835	ECA1CM100	CAP,E 10UF/16V
C1836	ECUX1H470JCX	CAP,C 47PF-J-50V
C1839	ECUX1H101JCX	CAP,C 100PF-J-50V
C1840	ECUX1H101JCX	CAP,C 100PF-J-50V
C1841	ECKF1H103ZF	CAP,C .01UF-Z-50V
C2201	AP335K016CAE	CAP,T 3.3UF/16V
C2202	ECA1EM4R7	CAP,E 4.7UF/25V
C2203	ECA1HM010	CAP,E 1.0UF/50V
C2204	ECA1EM4R7	CAP,E 4.7UF/25V
C2205	ECA1EM4R7	CAP,E 4.7UF/25V
C2206	ECA1EM4R7	CAP,E 4.7UF/25V
C2207	ECA1EM4R7	CAP,E 4.7UF/25V
C2208	ECA1EM4R7	CAP,E 4.7UF/25V
C2209	ECA1AM101	CAP,E 100UF/10V
C2210	ECA1HMR33	CAP,E .33UF/50V
C2211	ECEA1HUR68	CAP,E .68UF/50V
C2212	ECA1HM2R2	CAP,E 2.2UF/50V
C2213	ECA1EM100	CAP,E 10UF/25V
C2214	ECQB1H104JF	CAP,P .1UF-J-50V
C2215	ECQB1H223JF	CAP,P .022UF-J-50V
C2216	ECUX1H332KBX	CAP,C .0033UF-K-50V
C2217	ECEA1HN010U	CAP,E 1UF/50V
C2218	ECEA1HN010U	CAP,E 1UF/50V
C2219	AP106K016CAE	CAP,T 10UF/16V
C2220	ECEA1CN100U	CAP,E 10UF-16V
C2221	TCUX1H103KBN	CAP,C .01UF-K-50V
C2222	ECUX1H472KBX	CAP,C .0047UF-K-50V
C2302	ECA1HHG3R3B	CAP,E 3.3UF-50V
C2303	ECA1EHG100B	CAP,E 10UF-25V
C2304	ECQB1H104JF	CAP,P .1UF-J-50V
C2306	ECA1CM221	CAP,E 220UF/16V
C2307	ECEA1HN010U	CAP,E 1UF/50V
C2309	ECA1HHG010B	CAP,E 1UF-50V
C2310	ECUX1H332KBX	CAP,C .0033UF-K-50V
C2311	ECA1HM3R3	CAP,E 3.3UF/50V
C2351	ECA1EM102	CAP,E 1000UF/25V
C2352	ECA1HHG3R3B	CAP,E 3.3UF-50V
C2353	ECA1EHG100B	CAP,E 10UF-25V
C2354	ECQB1H104JF	CAP,P .1UF-J-50V
C2356	ECA1CM221	CAP,E 220UF/16V
C2357	ECEA1HN010U	CAP,E 1UF/50V
C2358	ECUX1H332KBX	CAP,C .0033UF-K-50V
C2451	ECA1EM100	CAP,E 10UF/25V *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
C2452	ECA1EM100	CAP,E 10UF/25V *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
C2453	ECA1EM4R7	CAP,E 4.7UF/25V *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
C2454	ECA1CM221	CAP,E 220UF/16V *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
C3001	ECA1HM010	CAP,E 1.0UF/50V
C3002	ECA1HM010	CAP,E 1.0UF/50V
C3003	ECA1HM010	CAP,E 1.0UF/50V
C3005	ECUX1H272KBX	CAP,C .0027UF-K-50V
C3006	ECUX1H272KBX	CAP,C .0027UF-K-50V
C4304	ECEA1CKA100	CAP,E 10UF/16V
C4305	ECEA1CN100U	CAP,E 10UF-16V
C4306	ECUX1H820JCX	CAP,C 82PF-J-50V
C4313	ECUX1H391KBX	CAP,C 390PF-K-50V
C4314	ECA1HM010	CAP,E 1.0UF/50V
C4315	ECUX1H152KBX	CAP,C .0015UF-K-50V
C4316	ECA0JM331	CAP,E 330UF/6.3V
C4317	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C4318	ECA0JM101	CAP,E 100UF/6.3V
C4319	ECUX1H391JCX	CAP,C 390PF-J-50V

REPLACEMENT PARTS LIST

(Models: CT-27G23W/CW/UW & SP2731W/UW)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
C4320	ECUX1H681KBX	CAP,C 680PF-K-50V
		DIODES
D001	ERA15-01	DIODE
D002	MA165	DIODE
D003	MA4047H	DIODE
D006	MA4330H	DIODE
D008	MA165	DIODE
D009	MA165	DIODE
D011	MA165	DIODE
D014	MA165	DIODE
D015	MA165	DIODE
D016	MA165	DIODE
D017	MA165	DIODE
D052	MA4068M	DIODE, ZENER
D451	ERA15-01	DIODE
D452	MA4047M	DIODE, ZENER
D453	MA165	DIODE
D501	MA4082L	DIODE
D531	**AS01**	**DIODE**
D532	**MA4062L**	**DIODE**
D551	**TVSRU2N**	**DIODE**
D553	**AU02**	**DIODE**
D554	**AU02**	**DIODE**
D555	MA165	DIODE
D556	MA4360H	DIODE, ZENER
D557	**AU02**	**DIODE**
D558	**RS3FS**	**DIODE**
D559	**BYD33G-113**	**DIODE**
D560	MA165	DIODE
D561	**AU02**	**DIODE**
D801	**GP15KL-042**	**DIODE**
D802	**GP15KL-042**	**DIODE**
D805	**TRPW5B0M050D**	**THERMISTOR**
D806	MA4047H	DIODE
D807	MA165	DIODE
D820	EU02V1	DIODE
D821	EU02V1	DIODE
D822	EU02V1	DIODE
D823	RL30A	DIODE
D824	EU02V1	DIODE
D825	**TVSSR2KL**	**DIODE, PROTECTION**
D826	EU02V1	DIODE
D829	MA165	DIODE
D2301	MA165	DIODE
D2302	MA165	DIODE
D2312	MA4068M	DIODE, ZENER
D3001	MA165	DIODE
D3002	MA4110M	DIODE, ZENER
D3003	MA4062M	DIODE, ZENER
D3004	MA4110M	DIODE, ZENER
D3005	MA4110M	DIODE, ZENER
D3012	MA4110M	DIODE, ZENER *CT-27G23CW*
		CT-27G23W *CT-27G23UW*
D3013	MA3110M	DIODE, ZENER *CT-27G23CW*
		CT-27G23W *CT-27G23UW*

REF. NO.	PART NO.	DESCRIPTION
D3014	MA3110M	DIODE, ZENER *CT-27G23CW*
		CT-27G23W *CT-27G23UW*
D3015	MA3110M	DIODE, ZENER *CT-27G23CW*
		CT-27G23W *CT-27G23UW*
D3016	MA3056M	DIODE
D4301	MA3036H	DIODE
		FUSES
F801	**0BA1C63NU100**	**FUSE, 6.3A/125V**
		INTEGRATED CIRCUITS
IC001	**MN1874085TJW**	**INT CKT**
IC002	24LC04BIP	INT CKT
IC101	**AN5165K**	**INT CKT**
IC451	**LA7838**	**INT CKT**
IC551	**AN78M09**	**PLUS 9V AVR**
IC552	AN78M05	PLUS 5V AVR
IC801	**0N3131R**	**INT CKT**
IC803	**STR58041A**	**INT CKT**
IC1801	M65617SP	PIP CONTROLLER
IC2201	AN5819K	INT CKT
IC2303	LA4285	INT CKT
IC2304	LA4285	INT CKT
IC2451	AN5285K	INT CKT *CT-27G23CW*
		CT-27G23W *CT-27G23UW*
IC4301	TC74HC4066AL	INT CKT
		COILS
L001	TLTABT2R2K	COIL, PEAKING 2.2UH
L002	ELESN390KA	COIL, PEAKING 39UH
L003	TLTABT2R2K	COIL, PEAKING 2.2UH
L004	TLTABT2R2K	COIL, PEAKING 2.2UH
L006	TSKA072	FERRITE BEAD
L008	TLTABT470K	COIL, PEAKING 47UH
L009	TSKA074	FERRITE BEAD
L103	TLTABT120K	COIL, PEAKING 12UH
L104	TLTABT1R0K	COIL, PEAKING 1.0UH
L105	EIV7EN053B	COIL, VCO
L106	ELESN180JA	COIL, PEAKING 18UH
L351	TLTABT101K	COIL, PEAKING
L551	**ELH5L7103**	**COIL**
L602	ELESN120JA	COIL, PEAKING 12UH
L801	**ELF17N017A**	**LINE FILTER *SP2731W* *SP2731UW***
		CT-27G23W ***CT-27G23UW***
L801	**ELF18D650K**	**CHOKE, AC LINE *CT-27G23CW***
L802	ELEIE680KA	COIL, PEAKING 68UH
L804	TSKA076	FERRITE BEAD
L1801	TLTACT1R5K	COIL, PEAKING
L1803	TLTACT2R2K	COIL, PEAKING 2.2UH
L1804	TLTACT150J	COIL, PEAKING 15UH
L1806	EXCELDR25	COIL
L1807	TLTACT1R0K	COIL, PEAKING 1UH
L1808	EXCELDR25	COIL
L2201	ELESN102JA	COIL, PEAKING 1000UH
L2202	ELESN471JA	COIL, PEAKING 470UH
L2302	TLTABT2R2K	COIL, PEAKING 2.2UH
L4301	TLTACT2R2K	COIL, PEAKING 2.2UH
J214	EXCELSA24T	FERRITE BEAD
J241	EXCELSA24T	FERRITE BEAD

REPLACEMENT PARTS LIST

(Models: CT-27G23W/CW/UW & SP2731W/UW)

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REF. NO.	PART NO.	DESCRIPTION
J253	TSKA074	FERRITE BEAD
	TRANSISTORS	
Q001	MSD601-RT1	TRANSISTOR
Q002	JC501PQ	TRANSISTOR
Q003	MSB709-RT1	TRANSISTOR
Q004	MSB709-RT1	TRANSISTOR
Q301	MSD601-RT1	TRANSISTOR
Q302	MSD601-RT1	TRANSISTOR
Q303	MSB709-RT1	TRANSISTOR
Q304	MSD601-RT1	TRANSISTOR
Q305	MSD601-RT1	TRANSISTOR
Q306	MSB709-RT1	TRANSISTOR
Q307	MSB709-RT1	TRANSISTOR
Q351	2SC3063	TRANSISTOR
Q352	2SC3063	TRANSISTOR
Q353	2SC3063	TRANSISTOR
Q430	MSD601-RT1	TRANSISTOR
Q451	MSD601-RT1	TRANSISTOR
Q452	MSD601-RT1	TRANSISTOR
Q501	2SC4212H	TRANSISTOR
Q551	**2SD2539MA1**	**TRANSISTOR**
Q801	2SC1685RSTA	TRANSISTOR
Q802	2SC1384RS	TRANSISTOR
Q804	2SA1767Q	TRANSISTOR
Q1801	MSD601-RT1	TRANSISTOR
Q1802	MSD601-RT1	TRANSISTOR
Q1803	MSD601-RT1	TRANSISTOR
Q1804	MSB709-RT1	TRANSISTOR
Q1805	MSB709-RT1	TRANSISTOR
Q2309	MSB709-RT1	TRANSISTOR
Q3001	MSD601-RT1	TRANSISTOR
Q4301	MSD601-RT1	TRANSISTOR
Q4302	MSD601-RT1	TRANSISTOR
Q4303	MSD601-RT1	TRANSISTOR
Q4309	MSB709-RT1	TRANSISTOR
Q4310	MSD601-RT1	TRANSISTOR
Q4311	MSB709-RT1	TRANSISTOR
Q4312	MSD601-RT1	TRANSISTOR
Q4313	MSD601-RT1	TRANSISTOR
Q4315	2SC1384Q	TRANSISTOR
	RELAYS	
RL801	**TSEH8007**	**RELAY**
	RESISTORS	
R002	ERJ6GEYJ182	RES,M 1.8K-J-1/10
R003	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R004	ERDS1TJ181	RES,C 180-J-1/2
R005	ERDS2TJ101	RES,C 100-J-1/4
R006	ERJ6GEYJ102	RES,M 1K-J-1/10
R007	ERJ6GEYJ102	RES,M 1K-J-1/10
R008	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R010	ERJ6GEYJ154	RES,M 150K-J-1/10
R011	ERJ6GEYJ684	RES,M 680K-J-1/10
R012	ERJ6GEYJ473	RES,M 47K-J-1/10
R014	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R015	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R016	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R017	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R020	ERJ6GEYJ474	RES,M 470K-J-1/10
R021	ERJ6GEYJ101	RES,M 100-J-1/10
R022	ERJ6GEYJ101	RES,M 100-J-1/10
R023	ERJ6GEYJ102	RES,M 1K-J-1/10
R025	ERJ6GEYJ223	RES,M 22K-J-1/10
R026	ERJ6GEYJ103	RES,M 10K-J-1/10
R027	ERJ6GEYJ223	RES,M 22K-J-1/10
		SP2731W *SP2731UW*
R028	**ERJ6GEYJ103**	**RES,M 10K-J-1/10**
R030	ERJ6GEYJ102	RES,M 1K-J-1/10
R032	ER0S2CKF1002	RES,M 10K-F-1/4
R033	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R034	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R035	ERJ6GEYJ332	RES,M 3.3K-J-1/10
R036	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R037	ERJ6GEYJ103	RES,M 10K-J-1/10
R038	ERJ6GEYJ223	RES,M 22K-J-1/10
R039	ERDS2TJ102	RES,C 1K-J-1/4
R041	ERJ6GEYJ471	RES,M 470-J-1/10
R042	ERJ6GEYJ223	RES,M 22K-J-1/10
R046	ERDS2TJ102	RES,C 1K-J-1/4
R048	ERJ6GEYJ221	RES,M 220-J-1/10
R049	ERJ6GEYJ221	RES,M 220-J-1/10
R053	ERJ6GEYJ103	RES,M 10K-J-1/10
R055	ERJ6GEYJ103	RES,M 10K-J-1/10
R060	ERJ6GEYJ102	RES,M 1K-J-1/10
R065	ERJ6GEYJ471	RES,M 470-J-1/10
R066	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R067	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R068	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R070	ERJ6GEYJ101	RES,M 100-J-1/10
R101	ERJ6GEYJ750	RES,M 75-J-1/10
R102	ERJ6GEYJ683	RES,M 68K-J-1/10
R103	ERJ6GEYJ183	RES,M 18K-J-1/10
R104	ERJ6GEYJ681	RES,M 680-J-1/10
R105	ERJ6GEYJ681	RES,M 680-J-1/10
R107	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R108	ERJ6GEYJ471	RES,M 470-J-1/10
R152	ERDS2TJ183	RES,C 18K-J-1/4
R153	ERJ6GEYJ223	RES,M 22K-J-1/10
R154	ERJ6GEYJ393	RES,M 39K-J-1/10
R201	ERJ6GEYJ471	RES,M 470-J-1/10
R202	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R203	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R301	ERJ6GEYJ471	RES,M 470-J-1/10
R302	ERJ6GEYJ681	RES,M 680-J-1/10
R303	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R304	ERJ6GEYJ332	RES,M 3.3K-J-1/10
R305	ER0S2CKF3001	RES,M 3K-F-1/4
R306	ERJ6ENF1651	RES,M 1.65K-F-1/10
R307	ERJ6GEYJ564	RES,M 560K-J-1/10
R308	ERJ6GEYJ102	RES,M 1K-J-1/10
R309	ERJ6GEYJ393	RES,M 39K-J-1/10
R310	ERJ6GEYJ393	RES,M 39K-J-1/10
R311	ERJ6GEYJ185	RES,M 1.8MEG-J-1/10W

REPLACEMENT PARTS LIST

(Models: CT-27G23W/CW/UW & SP2731W/UW)

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REF. NO.	PART NO.	DESCRIPTION
R313	ERJ6GEYJ471	RES,M 470-J-1/10
R314	ERDS2TJ471	RES,C 470-J-1/4
R315	ERJ6GEYJ101	RES,M 100-J-1/10
R317	ERJ6GEYJ684	RES,M 680K-J-1/10
R319	ERJ6GEYJ122	RES,M 1.2K-J-1/10
R320	ERJ6GEYJ102	RES,M 1K-J-1/10
R324	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R325	ERJ6GEYJ102	RES,M 1K-J-1/10
R326	ERJ6GEYJ332	RES,M 3.3K-J-1/10
R327	ERJ6GEYJ332	RES,M 3.3K-J-1/10
R328	ERJ6GEYJ102	RES,M 1K-J-1/10
R335	ERJ6GEYJ471	RES,M 470-J-1/10
R351	ERG2FJ123H	RES,M 12K-J-2W
R352	ERG2FJ123H	RES,M 12K-J-2W
R353	ERG2FJ123H	RES,M 12K-J-2W
R354	ERDS1TJ272	RES,C 2.7K-J-1/2
R355	ERDS1TJ272	RES,C 2.7K-J-1/2
R356	ERDS1TJ272	RES,C 2.7K-J-1/2
R357	ERDS2TJ271	RES,C 270-J-1/4
R358	ERDS2TJ271	RES,C 270-J-1/4
R359	ERDS2TJ271	RES,C 270-J-1/4
R360	ERDS2TJ751	RES,C 750-J-1/4
R361	ERDS2TJ751	RES,C 750-J-1/4
R362	ERDS2TJ751	RES,C 750-J-1/4
R363	ERDS2TJ101	RES,C 100-J-1/4
R364	ERDS2TJ101	RES,C 100-J-1/4
R365	ERDS2TJ101	RES,C 100-J-1/4
R401	ERJ6GEYJ102	RES,M 1K-J-1/10
R430	ERJ6GEYJ103	RES,M 10K-J-1/10
R432	ERJ6GEYJ102	RES,M 1K-J-1/10
R451	ERDS1FJ1R0	RES,C 1.0-J-1/2
R454	ERJ6GEYJ473	RES,M 47K-J-1/10
R455	ERJ6GEYJ183	RES,M 18K-J-1/10
R456	ERJ6GEYJ223	RES,M 22K-J-1/10
R457	ERJ6GEYJ152	RES,M 1.5K-J-1/10
R458	ERJ6GEYJ333	RES,M 33K-J-1/10
R459	ERJ6GEYJ683	RES,M 68K-J-1/10
R460	ERDS2TJ102	RES,C 1K-J-1/4
R462	ERJ6GEYJ473	RES,M 47K-J-1/10
R463	ERJ6GEYJ473	RES,M 47K-J-1/10
R464	ERDS1FJ1R5	RES,C 1.5-J-1/2
R465	ERJ6GEYJ103	RES,M 10K-J-1/10
R466	ERJ6GEYJ103	RES,M 10K-J-1/10
R467	ERJ6GEYJ104	RES,M 100K-J-1/10
R468	ERJ6GEYJ101	RES,M 100-J-1/10
R469	ERJ6GEYJ220	RES,M 22-J-1/10
R471	ERJ6GEYJ223	RES,M 22K-J-1/10
R501	ERJ6GEYJ102	RES,M 1K-J-1/10
R502	ERDS2TJ562	RES,C 5.6K-J-1/4
R503	ERJ6GEYJ822	RES,M 8.2K-J-1/10
R504	ERJ6GEYJ561	RES,M 560-J-1/10
R505	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R506	ERJ6GEYJ182	RES,M 1.8K-J-1/10
R507	ERJ6GEYJ392	RES,M 3.9K-J-1/10
R508	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R509	ERDS2TJ331	RES,C 330-J-1/4

REF. NO.	PART NO.	DESCRIPTION
R510	ERG3FJ362H	RES,M 3.6K-J-3W
R511	ERG3FJ362H	RES,M 3.6K-J-3W
R512	ERG2FJ392H	RES,M 3.9K-J-2W
R515	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R531	**ERD25FJ470**	**RES,C 47-J-1/4**
R532	**ERJ6ENF5602**	**RES,M 56K-F-1/10**
R533	**ERJ6ENF2102**	**RES,M 21K-F-1/10**
R536	ERJ6GEYJ223	RES,M 22K-J-1/10
R537	ERJ6GEYJ473	RES,M 47K-J-1/10
R551	**ERDS1FJ1R0**	**RES,C 1.0-J-1/2**
R552	**ERDS1FJ1R0**	**RES,C 1.0-J-1/2**
R553	**ERDS1FJ1R0**	**RES,C 1.0-J-1/2**
R554	ERG2FJ390H	RES,M 39-J-2W
R556	ERDS2TJ272	RES,C 2.7K-J-1/4
R557	ERDS2TJ103	RES,C 10K-J-1/4
R558	**ERQ1CKPR56**	**RES,F .56-K-1W**
R559	ERG2FJ683H	RES,M 12K-J-2W
R560	ERG2FJ182H	RES,M 1.8K-J-2W
R561	ERG2FJ102H	RES,M 1K-J-2W
R563	ERDS2TJ393	RES,C 39K-J-1/4
R564	ERDS2TJ104	RES,C 100K-J-1/4
R565	ERDS2TJ103	RES,C 10K-J-1/4
R566	**ERDS1FJ1R0**	**RES,C 1.0-J-1/2**
R602	ERJ6GEYJ331	RES,M 330-J-1/10
R603	ERJ6GEYJ331	RES,M 330-J-1/10
R604	ERJ6GEYJ331	RES,M 330-J-1/10
R611	ERJ6GEYJ333	RES,M 33K-J-1/10
R612	ERJ6GEYJ333	RES,M 33K-J-1/10
R613	ERJ6GEYJ333	RES,M 33K-J-1/10
R614	ERJ6GEYJ332	RES,M 3.3K-J-1/10
R801	**ERF7ZK1R5**	**RES,W 1.5-K-7W**
R805	ERDS2TJ274	RES,C 270K-J-1/4
R806	ERDS2TJ274	RES,C 270K-J-1/4
R808	ERDS1FJ1R0	RES,C 1.0-J-1/2
R809	ERDS1FJ1R0	RES,C 1.0-J-1/2
R810	ERDS1FJ272	RES,C 2.7K-J-1/2
R812	ERDS1TJ183	RES,C 18K-J-1/2
R813	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R815	**ERC12ZGM825**	**RES,S 8.2MEG-M-1/2**
R820	ERJ6GEYJ153	RES,M 15K-J-1/10
R821	ERJ6GEYJ392	RES,M 3.9K-J-1/10
R822	ERD50FJ474	RES,C 470K-J-1/2W
R823	ERDS2TJ222	RES,C 2.2K-J-1/4
R824	ERG3FJ390	RES,M 39-J-3W
R825	ERDS2TJ102	RES,C 1K-J-1/4
R826	ERF2AKR22	RES,W .22-K-2W
R827	ERDS1FJ561	RES,C 560-J-1/2
R828	ERG3FJ470H	RES,M 47-J-3W
R829	ERQ14AJ180	RES,F 180-J-1/4
R1801	ERJ6GEYJ301	RES,M 300-J-1/10
R1802	ERJ6GEYJ104	RES,M 100K-J-1/10
R1803	ERJ6GEYJ474	RES,M 470K-J-1/10
R1804	ERJ6GEYJ202	RES,M 2K-J-1/10
R1805	ERJ6GEYJ102	RES,M 1K-J-1/10
R1807	ERJ6GEYJ103	RES,M 10K-J-1/10
R1808	ERJ6GEYJ103	RES,M 10K-J-1/10

REPLACEMENT PARTS LIST

(Models: CT-27G23W/CW/UW & SP2731W/UW)

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REF. NO.	PART NO.	DESCRIPTION
R1809	ERJ6GEYJ473	RES,M 47K-J-1/10
R1810	ERJ6GEYJ103	RES,M 10K-J-1/10
R1811	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R1812	ERJ6GEYJ153	RES,M 15K-J-1/10
R1813	ERJ6GEYJ153	RES,M 15K-J-1/10
R1814	ERJ6GEYJ361	RES,M 360-J-1/10
R1815	ERJ6GEYJ471	RES,M 470-J-1/10
R1818	ERJ6GEYJ101	RES,M 100-J-1/10
R1819	ERJ6GEYJ101	RES,M 100-J-1/10
R1822	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R1823	ERJ6GEYJ473	RES,M 47K-J-1/10
R1825	ERJ6GEYJ471	RES,M 470-J-1/10
R1827	ERJ6GEYJ102	RES,M 1K-J-1/10
R1828	ERJ6GEYJ471	RES,M 470-J-1/10
R1830	ERJ6GEYJ102	RES,M 1K-J-1/10
R1856	ERJ6GEYJ153	RES,M 15K-J-1/10
R2201	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R2202	ERJ6GEYJ153	RES,M 15K-J-1/10
R2203	ERJ6GEYJ104	RES,M 100K-J-1/10
R2204	ERJ6GEYJ473	RES,M 47K-J-1/10
R2205	ERJ6GEYJ154	RES,M 150K-J-1/10
R2206	ERJ6GEYJ102	RES,M 1K-J-1/10
R2207	ERJ6GEYJ102	RES,M 1K-J-1/10
R2208	ERJ6ENF9102	RES,M 91K-F-1/10
R2212	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R2301	ERQ2CJP120	RES,F 12-J-2W
R2303	ERD25FJ1R0	RES,C 1.0-J-1/4
R2306	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R2311	ERJ6GEYJ332	RES,M 3.3K-J-1/10
R2312	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R2313	ERJ6GEYJ683	RES,M 68K-J-1/10
R2314	ERJ6GEYJ104	RES,M 100K-J-1/10
R2317	ERJ6GEYJ561	RES,M 560-J-1/10
R2318	ERJ6GEYJ103	RES,M 10K-J-1/10
R2319	ERDS2TJ562	RES,C 5.6K-J-1/4
R2321	ERDS2TJ101	RES,C 100-J-1/4
R2322	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R2353	ERD25FJ1R0	RES,C 1.0-J-1/4
R2356	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R2357	ERJ6GEYJ103	RES,M 10K-J-1/10 *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
R2358	ERJ6GEYJ122	RES,M 1.2K-J-1/10 *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
R2359	ERJ6GEYJ103	RES,M 10K-J-1/10 *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
R2360	ERJ6GEYJ122	RES,M 1.2K-J-1/10 *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
R2361	ERJ6GEYJ681	RES,M 680-J-1/10
R2362	ERJ6GEYJ681	RES,M 680-J-1/10
R2451	ERJ6GEYJ225	RES,M 2.2MEG-J-1/10 *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
R2455	ERJ6GEYJ243	RES,M 24K-J-1/10 *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
R2456	ERJ6GEYJ223	RES,M 22K-J-1/10 *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
R3001	ERJ6GEYJ473	RES,M 47K-J-1/10
R3002	ERJ6GEYJ104	RES,M 100K-J-1/10
R3005	ERDS2TJ750	RES,C 75-J-1/4
R3006	ERDS2TJ391	RES,C 390-J-1/4
R3009	ERDS2TJ682	RES,C 6.8K-J-1/4
R3010	ERJ6GEYJ334	RES,M 330K-J-1/10
R3011	ERDS2TJ682	RES,C 6.8K-J-1/4
R3012	ERDS2TJ334	RES,C 330K-J-1/4
R4301	ERJ6GEYJ471	RES,M 470-J-1/10
R4303	ERJ6GEYJ123	RES,M 12K-J-1/10
R4305	ERJ6GEYJ102	RES,M 1K-J-1/10
R4306	ERJ6GEYJ102	RES,M 1K-J-1/10
R4307	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R4308	ERJ6GEYJ104	RES,M 100K-J-1/10
R4309	ERJ6GEYJ103	RES,M 10K-J-1/10
R4326	ERJ6GEYJ471	RES,M 470-J-1/10
R4327	ERJ6GEYJ331	RES,M 330-J-1/10
R4328	ERJ6GEYJ560	RES,M 56-J-1/10
R4329	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R4330	ERJ6GEYJ561	RES,M 560-J-1/10
R4331	ERJ6GEYJ471	RES,M 470-J-1/10
R4332	ERJ6GEYJ393	RES,M 39K-J-1/10
R4333	ERJ6GEYJ334	RES,M 330K-J-1/10
R4334	ERJ6GEYJ152	RES,M 1.5K-J-1/10
R4336	ERJ6GEYJ680	RES,M 68-J-1/10
R4338	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R4339	ERJ6GEYJ102	RES,M 1K-J-1/10
R4340	ERJ6GEYJ471	RES,M 470-J-1/10
R4341	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R4342	ERJ6GEYJ223	RES,M 22K-J-1/10
R4343	ERJ6GEYJ101	RES,M 100-J-1/10
R4344	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R4345	ERJ6GEYJ103	RES,M 10K-J-1/10
R4350	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R4351	ERJ6GEYJ183	RES,M 18K-J-1/10
		SWITCHES
S001	EVQPF106K	SWITCH *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
S001	EVQQKH06K	SWITCH, PUSH *SP2731W* *SP2731UW*
S002	EVQPF106K	SWITCH *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
S002	EVQQKH06K	SWITCH, PUSH *SP2731W* *SP2731UW*
S003	EVQPF106K	SWITCH *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
S003	EVQQKH06K	SWITCH, PUSH *SP2731W* *SP2731UW*
S004	EVQPF106K	SWITCH *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
S004	EVQQKH06K	SWITCH, PUSH *SP2731W* *SP2731UW*
S005	EVQPF106K	SWITCH *CT-27G23CW* *CT-27G23W* *CT-27G23UW*
S005	EVQQKH06K	SWITCH, PUSH *SP2731W* *SP2731UW*

REPLACEMENT PARTS LIST

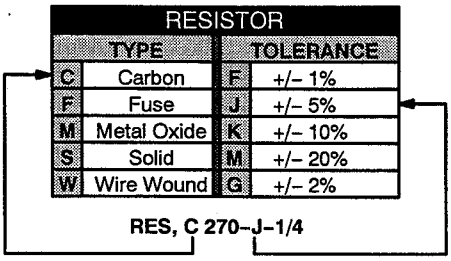
(Models: CT-27G23W/CW/UW & SP2731W/UW)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
S006	EVQQKH06K	SWITCH, PUSH *SP2731W SP2731UW*
S007	EVQQKH06K	SWITCH, PUSH *SP2731W SP2731UW*
S008	EVQPF106K	SWITCH *CT-27G23CW CT-27G23W CT-27G23UW*
S009	EVQPF106K	SWITCH *CT-27G23CW CT-27G23W CT-27G23UW*
S2301	ESB621283	SWITCH, CATV *CT-27G23CW CT-27G23W CT-27G23UW*
		TRANSFORMERS
T001	**TLP16297**	**TRANSFORMER, POWER SUPPLY**
T501	TLH15452	TRANSFORMER, HORIZONTAL DRIVER
T502	**ETE19Z30AY**	**TRANSFORMER, HORIZONTAL COUPLING**
T551	**KFT4AB143F**	**TRANSFORMER, FLYBACK**
T801	**ETS28AE219NC**	**TRANSFORMER**
		CRYSTALS/FILTERS
X001	TSS2080MX	CRYSTAL, 12 MHZ CLOCK
X101	M1969M	SAW FILTER
X102	EFCWS4504AB	FILTER 4.5MHZ
X201	EFCS4R5MS5W	FILTER 4.5MHZ BANDPASS
X501	TAFCSB503F38	CRYSTAL, CLOCK
X601	TSS2AA001	CRYSTAL, 3.58MHZ
X1801	TSSA050	CRYSTAL OSCILLATOR
		OTHERS
M001	EAS9D22A0	SPEAKER, 16 OHM/1.5W
TNR001	**ENV56D37G3**	**TUNER**
IC003	RPM-637CBRS1	IR RECEIVER, REMOTE CONTROL
M002	EUR511113	TRANSMITTER, REMOTE CONTROL *SP2731W SP2731UW*
M003	UR51EC883A	BATTERY COVER, REMOTE *SP2731W SP2731UW*
M004	EUR511170	TRANSMITTER, REMOTE CONTROL *CT-27G23W CT-27G23UW CT-27G23CW*
M005	UR51EC892A	BATTERY COVER, REMOTE *CT-27G23W CT-27G23UW CT-27G23CW*
M006	**M68LGL061X**	**CRT 27"**
M007	**TJSC00300**	**CRT SOCKET**
M008	TXF3A01ZER	ASSY, DAG GROUND

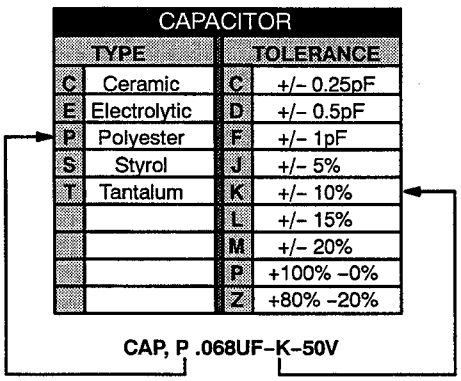
REF. NO.	PART NO.	DESCRIPTION
M009	TXFKU0197SER	ASSY, CABINET BACK 27" *CT-27G23W CT-27G23UW CT-27G23CW*
M010	TXFKY0497SER	ASSY, CABINET FRONT 27" *CT-27G23W CT-27G23UW CT-27G23CW*
M011	TXFKU0396SER	ASSY, CABINET BACK 27" *SP2731W SP2731UW*
M012	TXFKY5796SER	ASSY, CABINET FRONT 27" *SP2731W SP2731UW*
M013	TBM17454-2	BADGE, QUASAR *SP2731W SP2731UW*
M014	TBM2A10141	BADGE, PANASONIC *CT-27G23CW CT-27G23W CT-27G23UW*
M015	TBX1886601	PUSHBUTTON, SPEAKER
M016	TBX2AA00801G	BUTTON, 7-KEY *CT-27G23CW CT-27G23W CT-27G23UW*
M017	TBX2A50271	BUTTON, 7 KEY *SP2731W SP2731UW*
M018	TQB2AA0248	MANUAL, OWNERS *CT-27G23W CT-27G23UW*
M019	TQB2AA0249	MANUAL, OWNERS ENG/FRN *CT-27G23CW*
M020	TQB2AA0253	MANUAL, OWNERS ENG/SP *SP2731W SP2731UW*
M021	TQB2AA7017	REMOTE CONTROL GUIDE (ENG/SP) *SP2731W SP2731UW*
M022	TQB2AA7018	REMOTE CONTROL GUIDE (ENG/SP) *CT-27G23W CT-27G23UW*
M023	TQB2AA7020	REMOTE CONTROL GUIDE (ENG/FR) *CT-27G23CW*
M024	TMW2A97121	STRAIN RELIEF: AC LINE CORD
M025	**TSX2AA0011**	**LINE CORD**
M026	0FMK014ZZ	CONVERGENCE CORRECTOR STRIP
M027	ETC33X82NA	YOKE, CONVERGENCE
DY	**TLY2AA003**	**DEFLECTION YOKE**
M028	TMM2A30702	WEDGE, YOKE
DEG	**0LK19045A**	**COIL, DEGAUSSING 27"**
JK3001	TJB2A9063B	TERMINAL, A/V *CT-27G23CW CT-27G23W CT-27G23UW*
JK3001	TJB2A9064B	TERMINAL, A/V *SP2731W SP2731UW*
J214	EXCELSA24T	FERRITE BEAD
J241	EXCELSA24T	FERRITE BEAD
J253	TSKA074	FERRITE BEAD

DESCRIPTION OF ABBREVIATIONS GUIDE



RESISTOR			
TYPE		TOLERANCE	
C	Carbon	F	+/- 1%
F	Fuse	J	+/- 5%
M	Metal Oxide	K	+/- 10%
S	Solid	M	+/- 20%
W	Wire Wound	G	+/- 2%

RES, C 270-J-1/4



CAPACITOR			
TYPE		TOLERANCE	
C	Ceramic	C	+/- 0.25pF
E	Electrolytic	D	+/- 0.5pF
P	Polyester	F	+/- 1pF
S	Styrol	J	+/- 5%
T	Tantalum	K	+/- 10%
		L	+/- 15%
		M	+/- 20%
		P	+100% -0%
		Z	+80% -20%

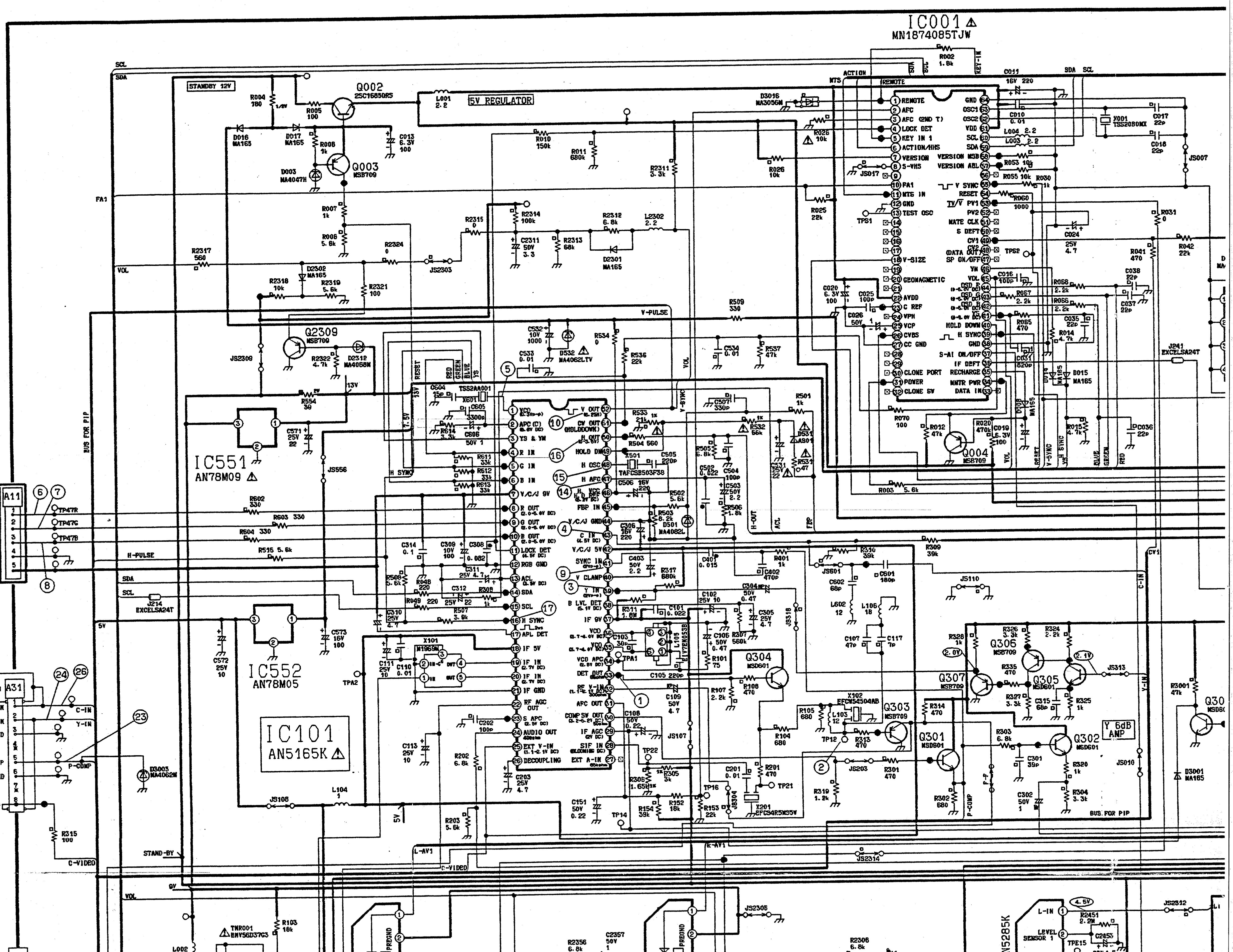
CAP, P .068UF-K-50V

A | B | C | D

1

2

3

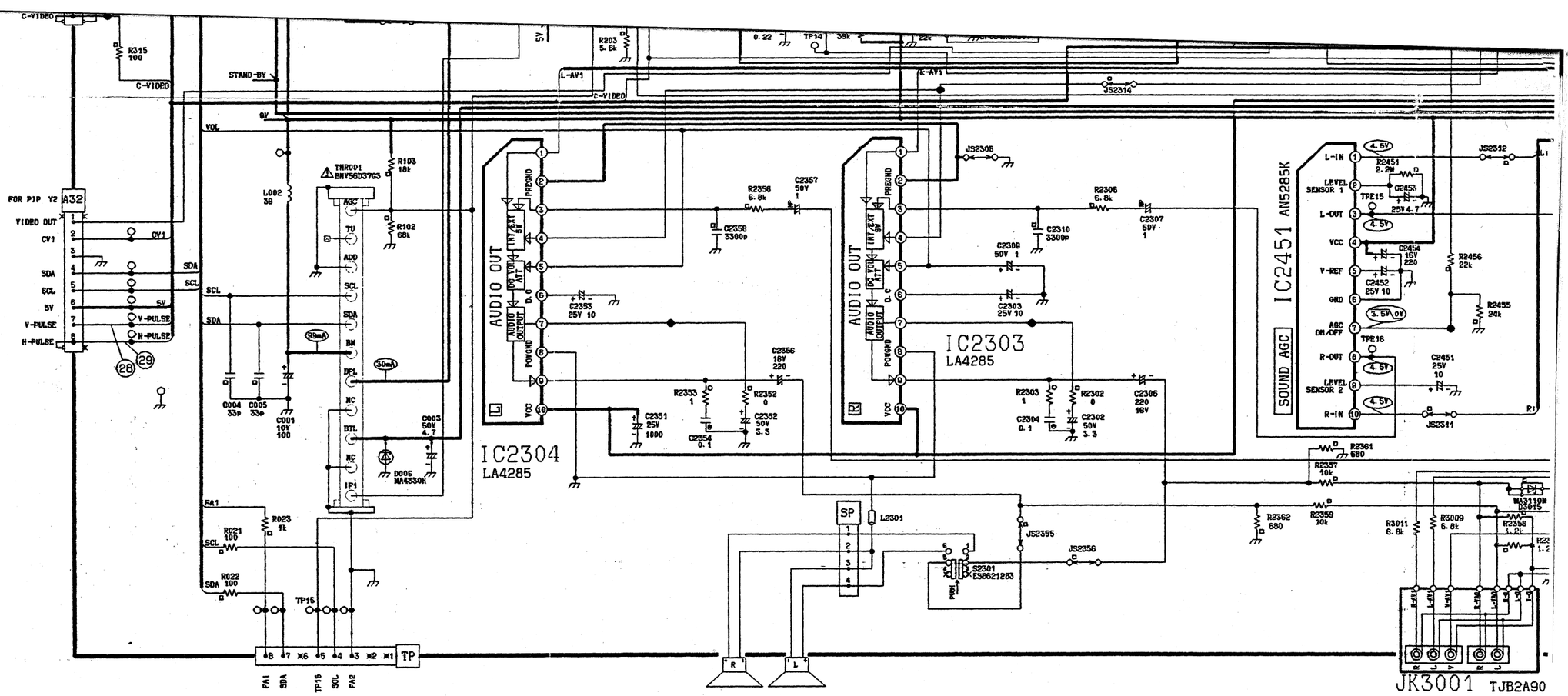


IC001 ⚠
MN1874085TJW
REMOTE
AFC
AFC (2ND T)
LOCK DET
KEY IN 1
ACTION/HHS
VERSION
S-VHS
FA1
MTS IN
GND
TEST OSC
V-SIZE
GEOMAGNETIC
AVDD
C REF
VPH
VCP
CVBS
CC GND
CLONE PORT
POWER
CLONE 5V
OSC1
OSC2
VDD
SCL
SDA
VERSION MSB
VERSION ABL
V SYNC
RESET
TV/V PV1
PV2
MATE CLK
S DEFT
CV1
CV2
DATA OUT/SP ON/OFF
YM
VOL
OSD R
OSD G
OSD B
YS
HOLD DOWN
H SYNC
S-AI ON/OFF
IF DEFT
RECHARGE
MNTR PWR
DATA IN
STANDBY 12V
Q002
2SC1685QRS
5V REGULATOR
Q003
MSB709
Q2309
MSB709
Q004
MSB709
IC551
AN78M09 ⚠
IC552
AN78M05
IC101
AN5165K ⚠
VCO
APC (C)
YS & YM
R IN
G IN
B IN
V/C/J 9V
R OUT
G OUT
B OUT
LOCK DET
RGB GND
ACL
SDA
SCL
H SYNC
APL DET
IF 5V
IF IN
IF GND
RF AGC OUT
S APC
AUDIO OUT
EXT V-IN
DECOUPLING
V OUT
CW OUT (HOLDDOWN)
H OUT
HOLD DN
H OSC
H AFC
H VCC
FBP IN
V/C/J GND
C IN
V/C/J 5V
SYNC IN
V CLAMP
Y IN
B LVL DET
IF 9V
VCO APC
DET OUT
RF V-IN
AFC OUT
COMP 5V OUT
IF AGC
SIF IN
EXT A-IN
A11
A31
FOR PIP
C-IN
Y-IN
GND
P-COMP
C-VIDEO
TP47R
TP47G
TP47B
H-PULSE
V-PULSE
BUS FOR PIP
J214 EXCELSA24T
J241 EXCELSA24T
STAND-BY
L-AV1
R-AV1
Q301 MSD601
Q302 MSD601
Q303 MSB709
Q304 MSD601
Q305 MSD601
Q306 MSB709
Q307 MSB709
Y 6dB AMP
X102 EFCW54504AB
X201 EFCS4R5MS5W
X001 TSS2080MX
TNR001 ENV56D37G3
L-IN
LEVEL SENSOR 1
PREGND

A-Board Schematic

CT-27G23W/UW/CW

CT-27G23W/UW/CW & SP2731W/UW



Waveforms – A-Board

1. 1.7V p-p [20µs] — IC101 PIN 33 (DET OUT)
2. 0.9V p-p [20µs] — TP12
3. 0.5V p-p [20µs] — IC101 PIN 39 (Y IN)
4. 0.38V p-p [20µs] — IC101 PIN 43 (C IN)
5. IC101 PIN 1 — 3.58VCO OSC Waveform
6. 3.28V p-p [20µs] — A11 PIN 1 (R) TP47R
7. 2.8V p-p [20µs] — A11 PIN 2 (G) TP47G
8. 3.7V p-p [20µs] — A11 PIN 3 (B) TP47B
9. 1.4V p-p [20µs] — IC101 PIN 41 (SYNC)
10. 4.3V p-p [5ms] — IC101 PIN 52 (VERT OUT)
11. 1.6V p-p [5ms] — IC451 PIN 7 (DRIVE)
12. 48.8V p-p [5ms] — IC451 PIN 12 (VERT OUT)
13. 26.6V p-p [5ms] — IC451 PIN 13
14. 1.7V p-p [20µs] — IC101 PIN 47 (H AFC)
15. IC101 PIN 48 — H OSC OSC Waveform
16. 3.56V p-p [20µs] — IC101 PIN 50 (H OUT)
17. 7.4V p-p [20µs] — IC101 PIN 16 (H SYNC)
18. 180V p-p [20µs] — Q501 collector (H DRIVE)
19. 258V p-p [20µs] — T551 PIN 1
20. 22.6V p-p [20µs] — T551 PIN 6
21. 282V p-p [5µs] — IC803 PIN 2
22. 284V p-p [5µs] — Collector of Q802

IC001

01	5.13	33	
02	2.82	34	
03	2.09	35	
04	3.38	36	
05	5.14	37	
06	2.84	38	
07	5.14	39	
08	0.00	40	
09	0.00	41	
10	5.13	42	
11	0.11	43	
12	0.00	44	
13	2.58	45	
14	N.C	46	
15	N.C	47	
16	N.C	48	
17	N.C	49	
18	0.56	50	
19	N.C	51	
20	N.C	52	
21	N.C	53	
22	5.14	54	
23	-0.04	55	
24	1.91	56	
25	1.37	57	
26	1.84	58	
27	0.00	59	
28	0.00	60	
29	0.00	61	
30	0.00	62	
31	5.09	63	
32	0.00	64	

**** WARNING**

CRT may shut off when probi

C D E F

A-Board Schematic
CT-27G23W/UW/CW

IC001 ⚠
MN1874085TJW

5V REGULATOR

IC002
24LC04BIP
I²C
EEPROM

IC2201
AN5819K
MTS

IC2451
AN5285K

Q004 MSB709
Q304 MSD601
Q305 MSD601
Q306 MSB709
Q307 MSB709
Q301 MSD601
Q303 MSB709
Q302 MSD601
Q3001 MSD601
Q001 MSD601
Q430 MSD601
Q802 2SC1384R5

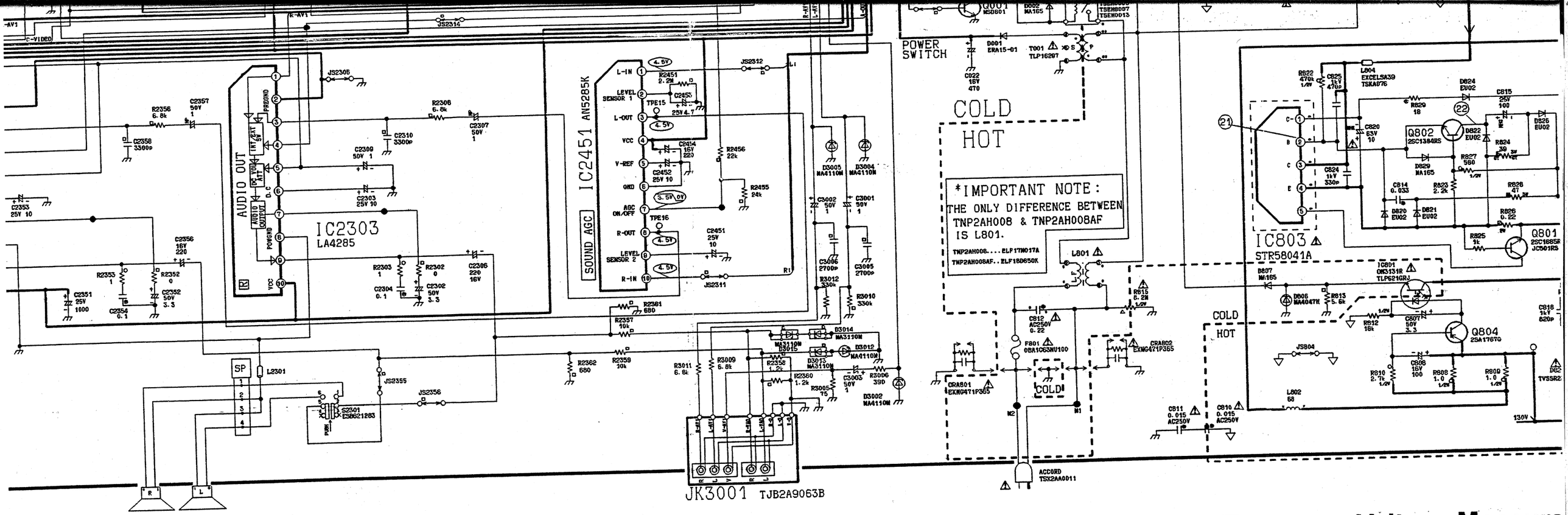
Y 6dB AMP

BUS FOR PIP

POWER SWITCH

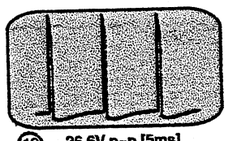
COLD

HOT

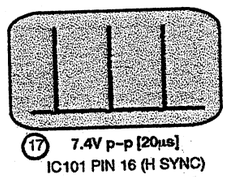


forms – A-Board

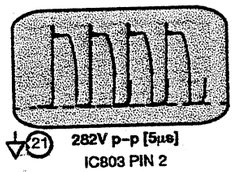
[20µs]
H1 (SYNC)



13 26.6V p–p [5ms]
IC451 PIN 13

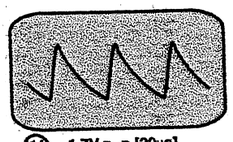


17 7.4V p–p [20µs]
IC101 PIN 16 (H SYNC)

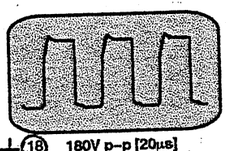


21 282V p–p [5µs]
IC803 PIN 2

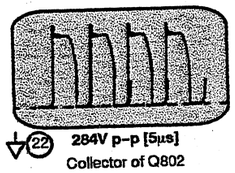
p [5ms]
2 (VERT OUT)



14 1.7V p–p [20µs]
IC101 PIN 47 (H AFC)



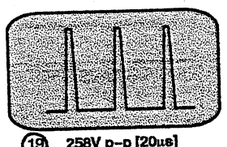
18 180V p–p [20µs]
Q501 collector (H DRIVE)



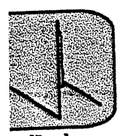
22 284V p–p [5µs]
Collector of Q802

p [5ms]
N 7 (DRIVE)

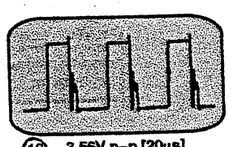
15 IC101 PIN 48
H OSC
OSC Waveform



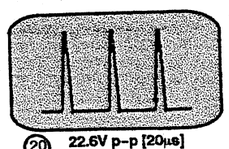
19 258V p–p [20µs]
T551 PIN 1



–p [5ms]
12 (VERT OUT)



16 3.56V p–p [20µs]
IC101 PIN 50 (H OUT)



20 22.6V p–p [20µs]
T551 PIN 6

Voltage Measure

IC001

01	5.13	33	0.00
02	2.82	34	0.01
03	2.09	35	5.14
04	3.38	36	0.00
05	5.14	37	5.14
06	2.84	38	0.00
07	5.14	39	0.17
08	0.00	40	4.09
09	0.00	41	0.02
10	5.13	42	0.00
11	0.11	43	0.00
12	0.00	44	0.00
13	2.58	45	0.17
14	N.C	46	-0.11
15	N.C	47	0.01
16	N.C	48	0.01
17	N.C	49	0.04
18	0.56	50	0.01
19	N.C	51	0.01
20	N.C	52	0.01
21	N.C	53	0.02
22	5.14	54	** 5.25
23	-0.04	55	4.03
24	1.91	56	0.01
25	1.37	57	0.00
26	1.84	58	0.00
27	0.00	59	3.73
28	0.00	60	3.67
29	0.00	61	5.15
30	0.00	62	2.53
31	5.09	63	2.25
32	0.00	64	0.00

IC101

01	2.90	27	4.31
02	5.62	28	3.19
03	0.00	29	2.61
04	0.01	30	2.97
05	0.01	31	5.26
06	0.01	32	2.05
07	8.84	33	2.77
08	3.53	34	2.61
09	3.44	35	3.35
10	3.50	36	3.35
11	4.19	37	8.83
12	0.00	38	3.93
13	3.55	39	4.15
14	3.72	40	2.82
15	3.67	41	4.23
16	0.28	42	4.90
17	3.44	43	4.38
18	4.90	44	0.00
19	2.72	45	0.35
20	2.72	46	6.13
21	0.00	47	4.13
22	2.58	48	2.22
23	5.59	49	5.41
24	4.29	50	0.89
25	1.70	51	6.22
26	6.06	52	4.03

IC002

01	0.00
02	0.00
03	0.00
04	0.00
05	3.73
06	3.67
07	0.00
08	5.15

IC451

01	8.74
02	4.03
03	4.38
04	4.44
05	0.02
06	4.37
07	4.27
08	27.00
09	2.97
10	1.32
11	0.02
12	16.82
13	27.94

IC551

01	13.68
02	0.00
03	8.85

IC552

01	8.05
02	0.00
03	4.92

IC2303

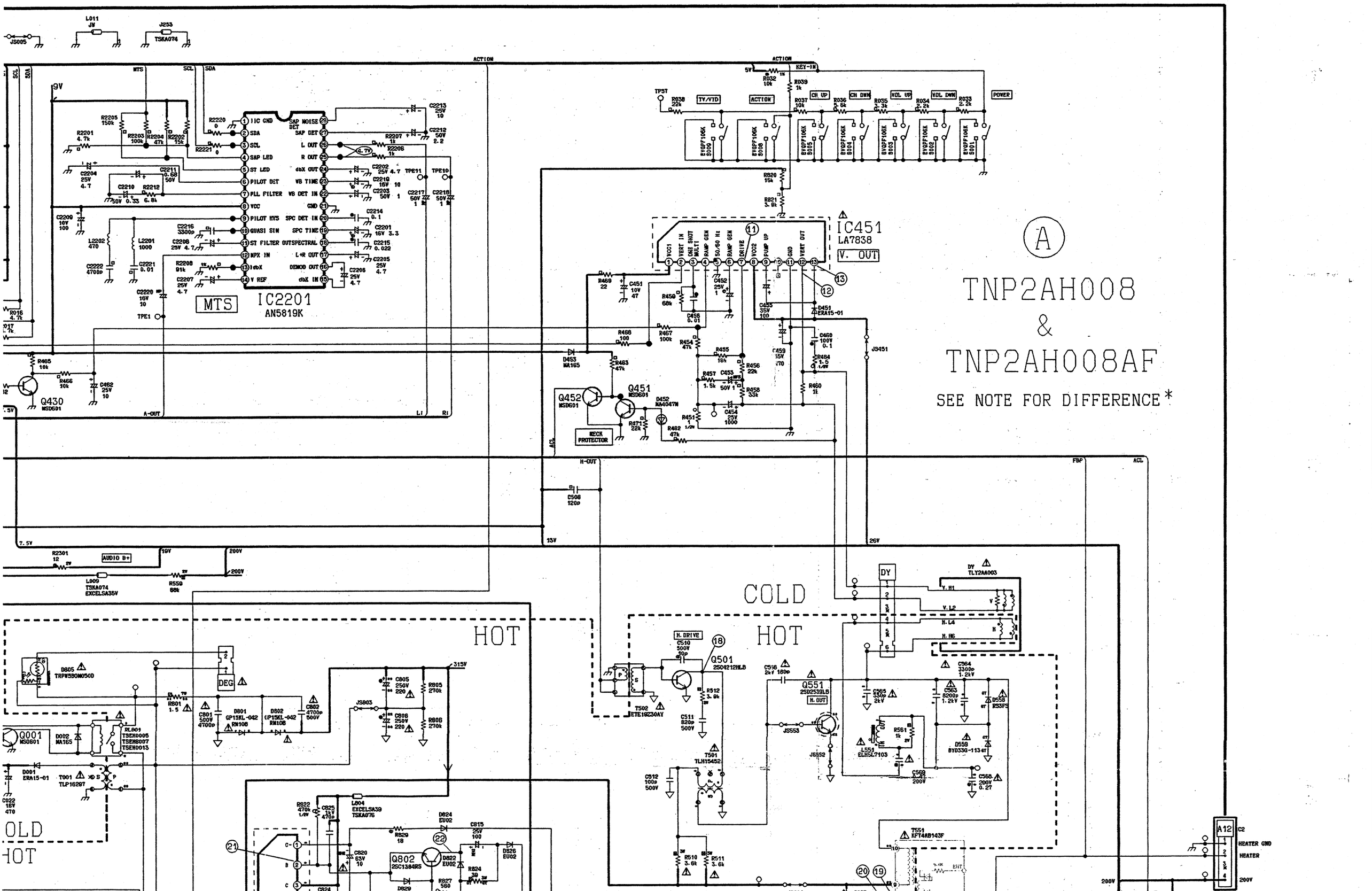
01	6.30
02	0.00
03	6.31
04	0.02
05	0.69
06	8.80
07	8.86
08	0.00
09	8.95
10	18.87

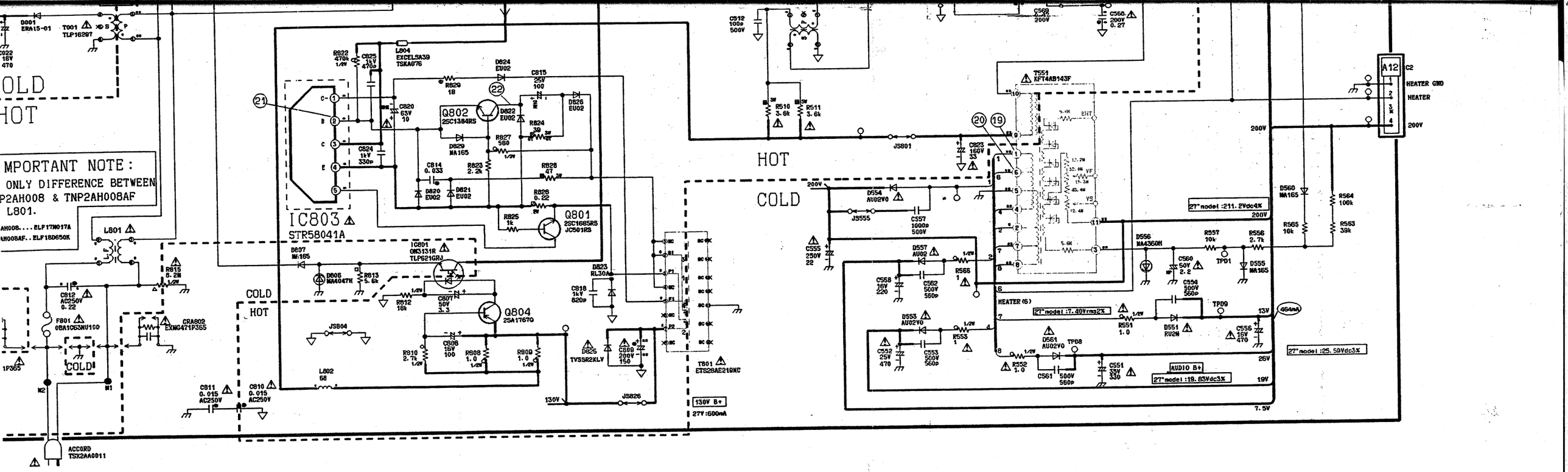
IC2304

01	6.28
02	0.00
03	6.28
04	0.02
05	0.69
06	8.78
07	8.82
08	0.00
09	8.91
10	18.86

**** WARNING**
CRT may shut off when probing pin. Shut Receiver off and turn back on to continue testing

ıematic
'UW/CW





Voltage Measurements A-Board

IC101			
01	2.90	27	4.31
02	5.62	28	3.19
03	0.00	29	2.61
04	0.01	30	2.97
05	0.01	31	5.26
06	0.01	32	2.05
07	8.84	33	2.77
08	3.53	34	2.61
09	3.44	35	3.35
10	3.50	36	3.35
11	4.19	37	8.83
12	0.00	38	3.93
13	3.55	39	4.15
14	3.72	40	2.82
15	3.67	41	4.23
16	0.28	42	4.90
17	3.44	43	4.38
18	4.90	44	0.00
19	2.72	45	0.35
20	2.72	46	6.13
21	0.00	47	4.13
22	2.58	48	2.22
23	5.59	49	5.41
24	4.29	50	0.89
25	1.70	51	6.22
26	6.06	52	4.03

IC002	
01	0.00
02	0.00
03	0.00
04	0.00
05	3.73
06	3.67
07	0.00
08	5.15

IC451	
01	8.74
02	4.03
03	4.38
04	4.44
05	0.02
06	4.37
07	4.27
08	27.00
09	2.97
10	1.32
11	0.02
12	16.82
13	27.94

IC2201			
01	0.00	15	3.74
02	3.73	16	4.46
03	3.67	17	4.50
04	0.12	18	4.41
05	0.10	19	0.70
06	6.06	20	4.47
07	2.72	21	0.00
08	8.85	22	4.46
09	4.48	23	0.72
10	4.47	24	4.29
11	4.47	25	4.68
12	4.35	26	4.36
13	3.03	27	5.00
14	4.47	28	4.85

IC551	
	13.68
	0.00
	8.85

IC552	
01	8.05
02	0.00
03	4.92

IC2303	
01	6.30
02	0.00
03	6.31
04	0.02
05	0.69
06	8.80
07	8.86
08	0.00
09	8.95
10	18.87

IC2304	
01	6.28
02	0.00
03	6.28
04	0.02
05	0.69
06	8.78
07	8.82
08	0.00
09	8.91
10	18.86

IC2451	
01	4.42
02	1.54
03	4.46
04	8.84
05	4.48
06	0.00
07	2.72
08	4.47
09	2.13
10	4.42

IC803 ⏚	
01	0.00
02	0.17
03	3.07
04	0.00
05	132.0

	Q001	Q002	Q003	Q004	Q301	Q302	Q303	Q304
B	0.71	5.82	4.93	5.14	2.96	2.33	1.14	2.77
C	0.06	11.08	5.77	0.00	8.84	8.83	0.00	8.83
E	0.00	5.14	5.79	0.01	2.34	1.74	1.83	2.16

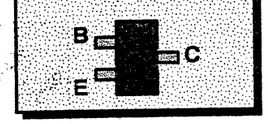
	Q305	Q306	Q307	Q430	Q451	Q452	Q501 ⏚	Q551 ⏚
B	1.67	6.53	1.78	0.36	0.65	0.02	0.00	0.00
C	6.53	1.76	0.00	3.08	0.00	3.65	99.70	127.70
E	1.07	7.14	2.46	0.00	0.00	0.02	0.00	0.00

	Q801 ⏚	Q802 ⏚	Q804 ⏚	Q2309	Q3001
B	0.00	130.60	130.30	6.91	0.00
C	132.00	131.50	0.60	0.00	8.93
E	0.00	131.20	130.70	0.69	0.00

IMPORTANT SAFETY NOTICE

THIS SCHEMATIC DIAGRAM INCORPORATES SPECIAL FEATURES THAT ARE IMPORTANT FOR PROTECTION FROM X-RADIATION, FIRE AND ELECTRICAL SHOCK HAZARDS. WHEN SERVICING IT IS ESSENTIAL THAT ONLY MANUFACTURERS SPECIFIED PARTS BE USED FOR THE CRITICAL COMPONENTS DESIGNATED WITH A ⚠ IN THE SCHEMATIC.

CHIP TRANSISTOR LEAD DESIGNATION



Board Index

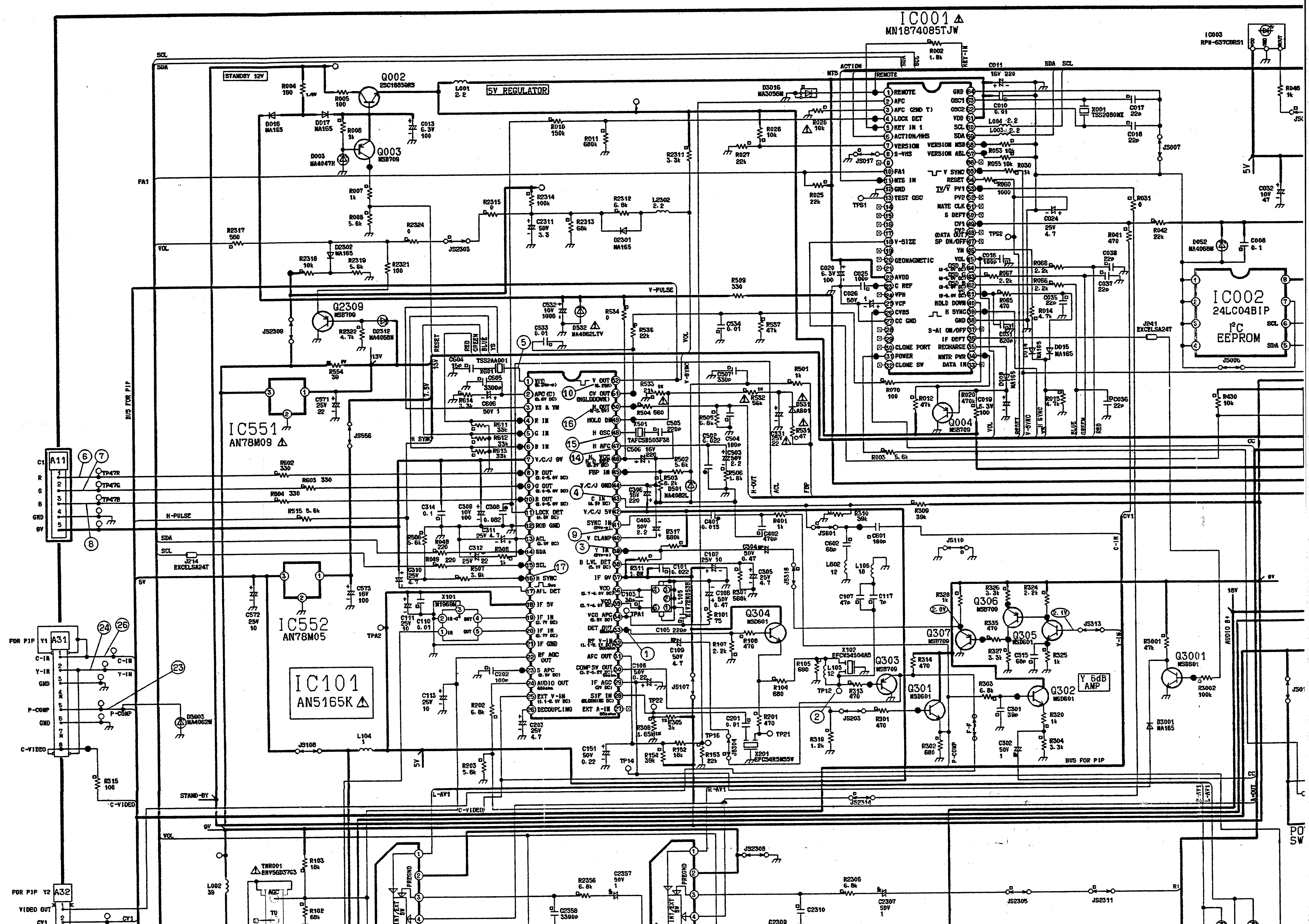
A-Board – Main Chassis
C-Board – CRT Board
Y-Board – PIP Processing

turn back on to continue testing

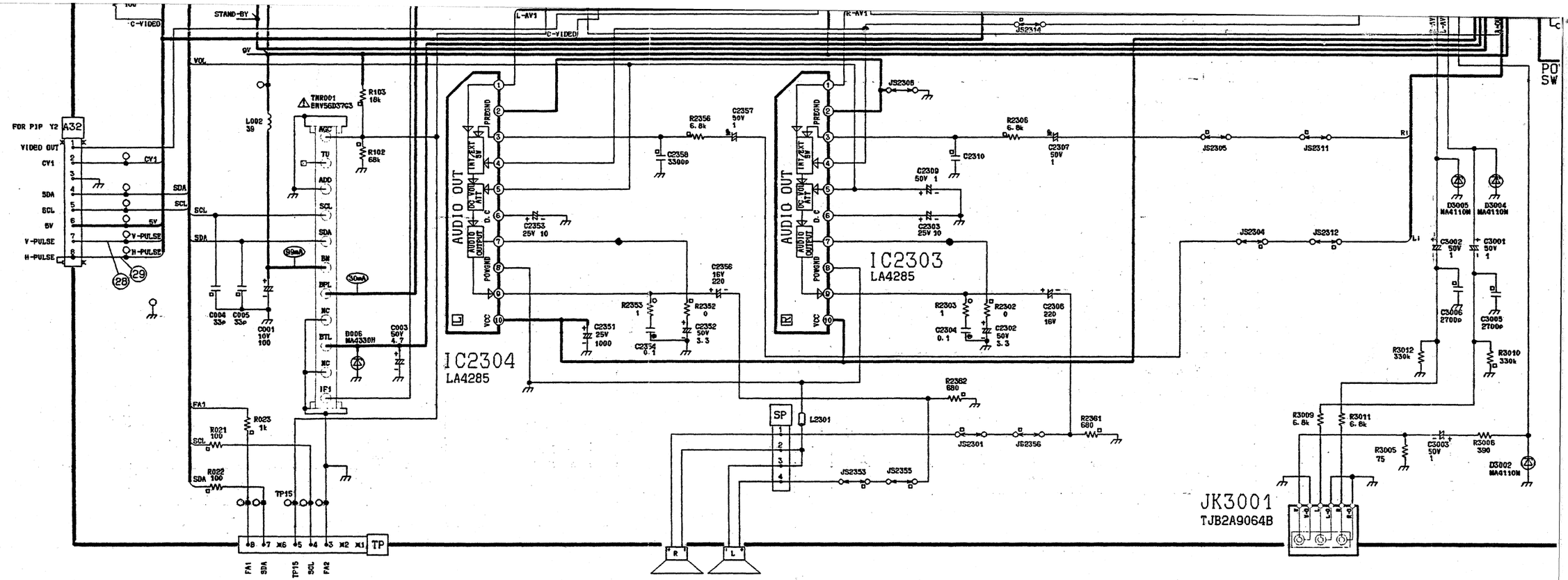
A B C D

A-Bo
S

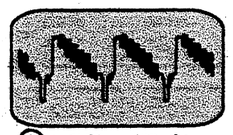
1
2
3



IC001 MN1B74085TJW
IC002 24LC04BIP I²C EEPROM
IC003 RPM-637CBRS1
IC551 AN78M09
IC552 AN78M05
IC101 AN5165K
5V REGULATOR
STANDBY 12V
Q002 2SC1685QRS
Q003 MSB709
Q004 MSB709
Q2309 MSB709
Q301 MSD601
Q302 MSD601
Q303 MSB709
Q304 MSD601
Q305 MSD601
Q306 MSB709
Q307 MSB709
Q3001 MSD601
Y 6dB AMP
BUS FOR PIP
FOR PIP Y1 A31
FOR PIP Y2 A32
A11
C-IN
Y-IN
GND
P-COMP
C-VIDEO
VIDEO OUT
CV1
R
G
B
9V
TP47R
TP47G
TP47B
H-PULSE
SDA
SCL
VOL
FA1
V-PULSE
STAND-BY
L-AV1
R-AV1
TNR001 ENV56D37G3
X001 TSS2080MX
X501 TAFCSB503F38
X601 TSS2AA001
X101 M1969M
X102 EFCV54504AB
X201 EFCS4R5MS5V
AUDIO B+
POW SW

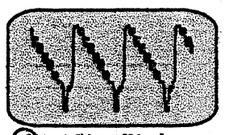


Waveforms – A-Board

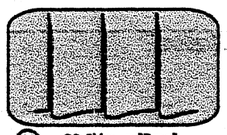


1 1.7V p-p [20µs]
IC101 PIN 33 (DET OUT)

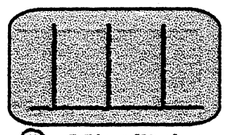
5 IC101 PIN 1
3.58VCO
OSC Waveform



9 1.4V p-p [20µs]
IC101 PIN 41 (SYNC)

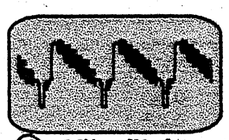


13 26.6V p-p [5ms]
IC451 PIN 13

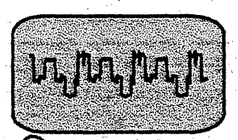


17 7.4V p-p [20µs]
IC101 PIN 16 (H SYNC)

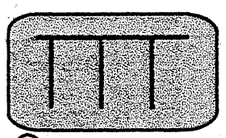
21 282V p-p [5µs]
IC803 PIN 2



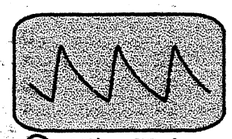
2 0.9V p-p [20µs]
TP12



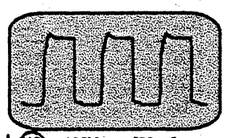
6 3.28V p-p [20µs]
A11 PIN 1 (R)
TP47R



10 4.3V p-p [5ms]
IC101 PIN 52 (VERT OUT)



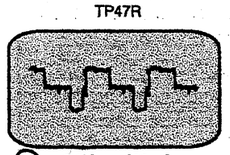
14 1.7V p-p [20µs]
IC101 PIN 47 (H AFC)



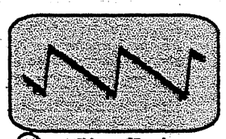
18 180V p-p [20µs]
Q501 collector (H DRIVE)

22 284V p-p [5µs]
Collector of Q802

3 0.5V p-p [20µs]
IC101 PIN 39 (Y IN)

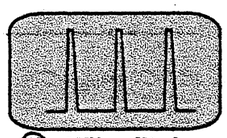


7 2.8V p-p [20µs]
A11 PIN 2 (G)
TP47G

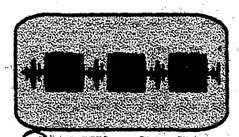


11 1.6V p-p [5ms]
IC451 PIN 7 (DRIVE)

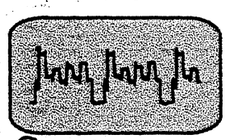
15 IC101 PIN 48
H OSC
OSC Waveform



19 258V p-p [20µs]
T551 PIN 1

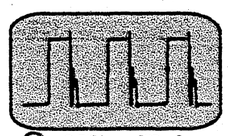


4 0.38V p-p [20µs]
IC101 PIN 43 (C IN)

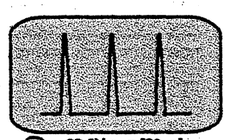


8 3.7V p-p [20µs]
A11 PIN 3 (B)
TP47B

12 48.8V p-p [5ms]
IC451 PIN 12 (VERT OUT)



16 3.56V p-p [20µs]
IC101 PIN 50 (H OUT)



20 22.6V p-p [20µs]
T551 PIN 6

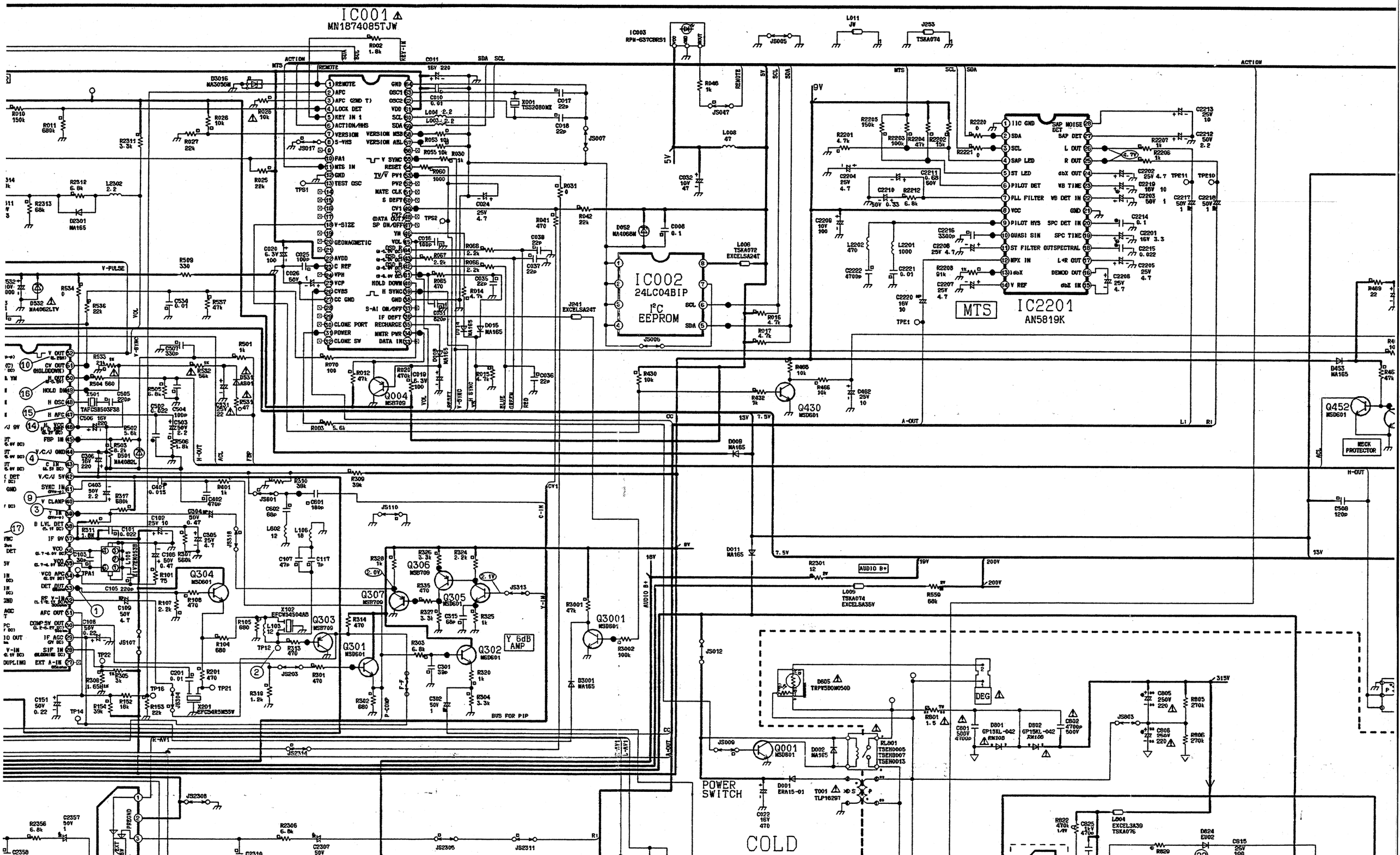
IC001

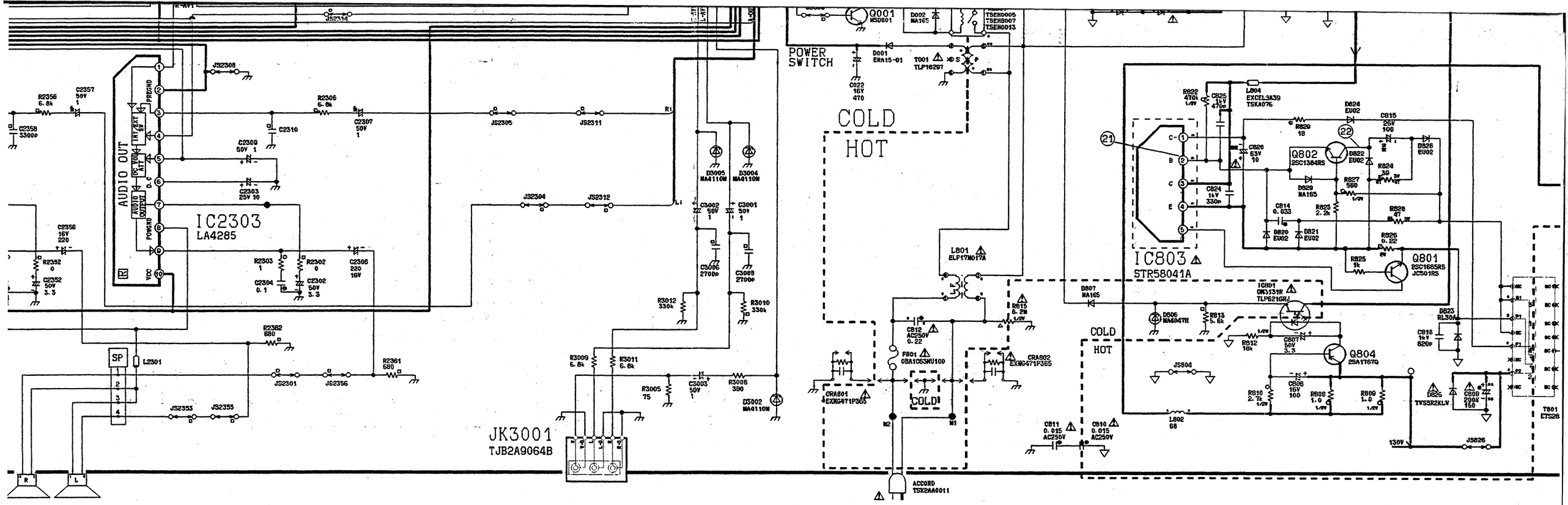
01	5.13	33	0.00
02	2.82	34	0.01
03	2.09	35	5.14
04	3.38	36	0.00
05	5.14	37	5.14
06	2.84	38	0.00
07	5.14	39	0.17
08	0.00	40	-4.09
09	0.00	41	0.02
10	5.13	42	0.00
11	0.11	43	0.00
12	0.00	44	0.00
13	2.58	45	0.17
14	N.C	46	-0.11
15	N.C	47	0.01
16	N.C	48	0.01
17	N.C	49	0.04
18	0.56	50	0.01
19	N.C	51	0.01
20	N.C	52	0.01
21	N.C	53	0.02
22	5.14	54	** 5.25
23	-0.04	55	4.03
24	1.91	56	0.01
25	1.37	57	0.00
26	1.84	58	0.00
27	0.00	59	3.73
28	0.00	60	3.67
29	0.00	61	5.15
30	0.00	62	2.53
31	5.09	63	2.25
32	0.00	64	0.00

**** WARNING**
CRT may shut off when probing pin. Shut Receiver of

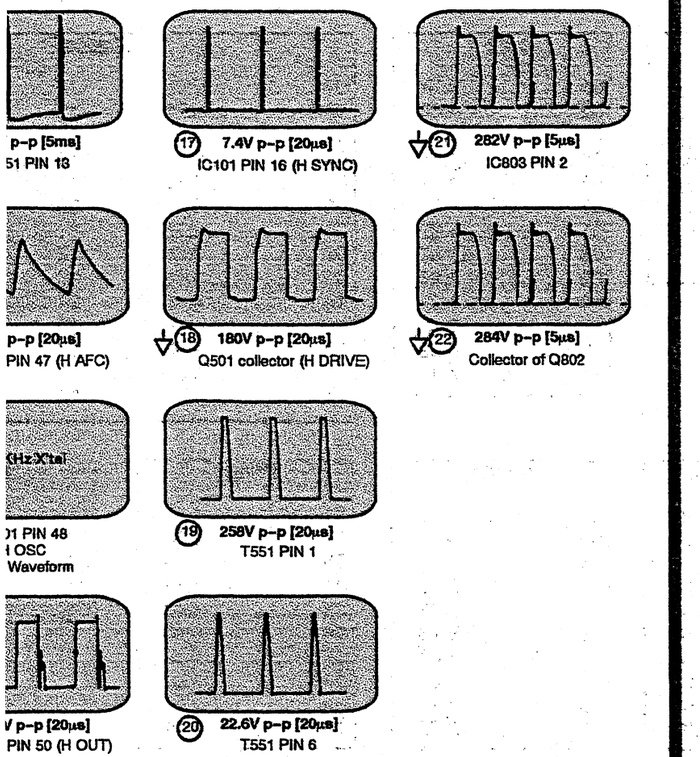
C D E F

A-Board Schematic
SP2731W/UW





Board



Voltage Measurements A–B

IC001			
01	5.13	33	0.00
02	2.82	34	0.01
03	2.09	35	5.14
04	3.38	36	0.00
05	5.14	37	5.14
06	2.84	38	0.00
07	5.14	39	0.17
08	0.00	40	4.09
09	0.00	41	0.02
10	5.13	42	0.00
11	0.11	43	0.00
12	0.00	44	0.00
13	2.58	45	0.17
14	N.C	46	-0.11
15	N.C	47	0.01
16	N.C	48	0.01
17	N.C	49	0.04
18	0.56	50	0.01
19	N.C	51	0.01
20	N.C	52	0.01
21	N.C	53	0.02
22	5.14	54	** 5.25
23	-0.04	55	4.03
24	1.91	56	0.01
25	1.37	57	0.00
26	1.84	58	0.00
27	0.00	59	3.73
28	0.00	60	3.67
29	0.00	61	5.15
30	0.00	62	2.53
31	5.09	63	2.25
32	0.00	64	0.00

IC101			
01	2.90	27	4.31
02	5.62	28	3.19
03	0.00	29	2.61
04	0.01	30	2.97
05	0.01	31	5.26
06	0.01	32	2.05
07	8.84	33	2.77
08	3.53	34	2.61
09	3.44	35	3.35
10	3.50	36	3.35
11	4.19	37	8.83
12	0.00	38	3.93
13	3.55	39	4.15
14	3.72	40	2.82
15	3.67	41	4.23
16	0.28	42	4.90
17	3.44	43	4.38
18	4.90	44	0.00
19	2.72	45	0.35
20	2.72	46	5.13
21	0.00	47	4.13
22	2.58	48	2.22
23	5.59	49	5.41
24	4.29	50	0.89
25	1.70	51	6.22
26	6.06	52	4.03

IC551	
01	13.68
02	0.00
03	8.85

IC552	
01	8.05
02	0.00
03	4.92

IC002	
01	0.00
02	0.00
03	0.00
04	0.00
05	3.73
06	3.67
07	0.00
08	5.15

IC451	
01	8.74
02	4.03
03	4.38
04	4.44
05	0.02
06	4.37
07	4.27
08	27.00
09	2.97
10	1.32
11	0.02
12	16.82
13	27.94

01	0.00
02	3.73
03	3.67
04	0.12
05	0.10
06	6.06
07	2.72
08	8.85
09	4.48
10	4.47
11	4.47
12	4.35
13	3.03
14	4.47

IC2303	
01	6.30
02	0.00
03	6.31
04	0.02
05	0.69
06	8.80
07	8.86
08	0.00
09	8.95
10	18.87

IC2304	
01	6.28
02	0.00
03	6.28
04	0.02
05	0.69
06	8.78
07	8.82
08	0.00
09	8.91
10	18.86

IC803 ⇄	
01	0.00
02	0.17
03	3.07
04	0.00
05	132.0

**** WARNING**
CRT may shut off when probing pin. Shut Receiver off and turn back on to continue testing

E F G H

C

TNP2AH008AD

A

MTS IC2201 AN5819K

COLD HOT

IC451 LA7838 V. OUT

Q451 MSD601

Q452 MSD601

Q501 2SC4212HLB

Q551 2SD2539LB

T502 ETE19Z30AY

T501 TLH15452

T551 KFT4AB143F

D451 ERA15-01

D452 MA4047M

D453 MA165

D801 GP15KL-042 RM10S

D802 GP15KL-042 RM10S

DY TLY2AA003

D559 RS3FS

D559 BYD33G-1134T

L2201 1000

L801 TSEH0005 TSEH0007 TSEH0013

L804 EXCEL3A39 TSKA076

J253 TSKA074

J5451

J5503

J6552

R801 1.5

R559 68k

R469 22

R459 68k

R467 100k

R468 100

R454 47k

R455 18k

R456 22k

R457 1.5k

R458 33k

R451 1/2W

R482 47k

R671 22k

R460 1k

R820 15k

R821 5.6k

R512 3.9k

R561 1k

R822 470k 1/2W

R829 18

R805 270k

R806 270k

R803 315V

R2205 150k

R2203 100k

R2204 47k

R2202 15k

R2220 0

R2221 0

R2207 1k

R2206 1k

R2208 91k

R2212 6.8k

C2211 0.68 50V

C2210 50V 0.33

C2216 3300p

C2208 25V 4.7

C2207 25V 4.7

C2220 16V 10

C2221 0.01

C2213 25V 10

C2212 50V 2.2

C2202 25V 4.7

C2219 16V 10

C2203 50V 1

C2217 50V 1

C2218 50V 1

C2214 0.1

C2201 16V 3.3

C2215 0.022

C2205 25V 4.7

C2206 25V 4.7

C451 10V 47

C452 25V 1

C453 50V 1

C454 25V 1000

C455 35V 100

C456 0.01

C459 35V 470

C460 100V 0.1

C464 1.5 1/4W

C508 120p

C510 500V 40p

C511 820p 500V

C512 100p 500V

C565 8200p 1.2kV

C564 3300p 1.2kV

C568 2kV 180p

C569 0.47 200V

C568 200V 0.27

C801 500V 4700p

C802 4700p 500V

C805 250V 220

C808 250V 220

C825 1kV 470p

C815 25V 100

C820 63V

D824 EU02

D826 EU02

D822

Q802

DEG

AUDIO B+

19V

200V

315V

H-OUT

FBP

ACL

13V

23V

A-OUT

L1

R1

MTS

SCL

SDA

KEY-IN

5V

TP57

TV/VID

ACTION

CH UP

CH DWN

VOL UP

VOL DWN

POWER

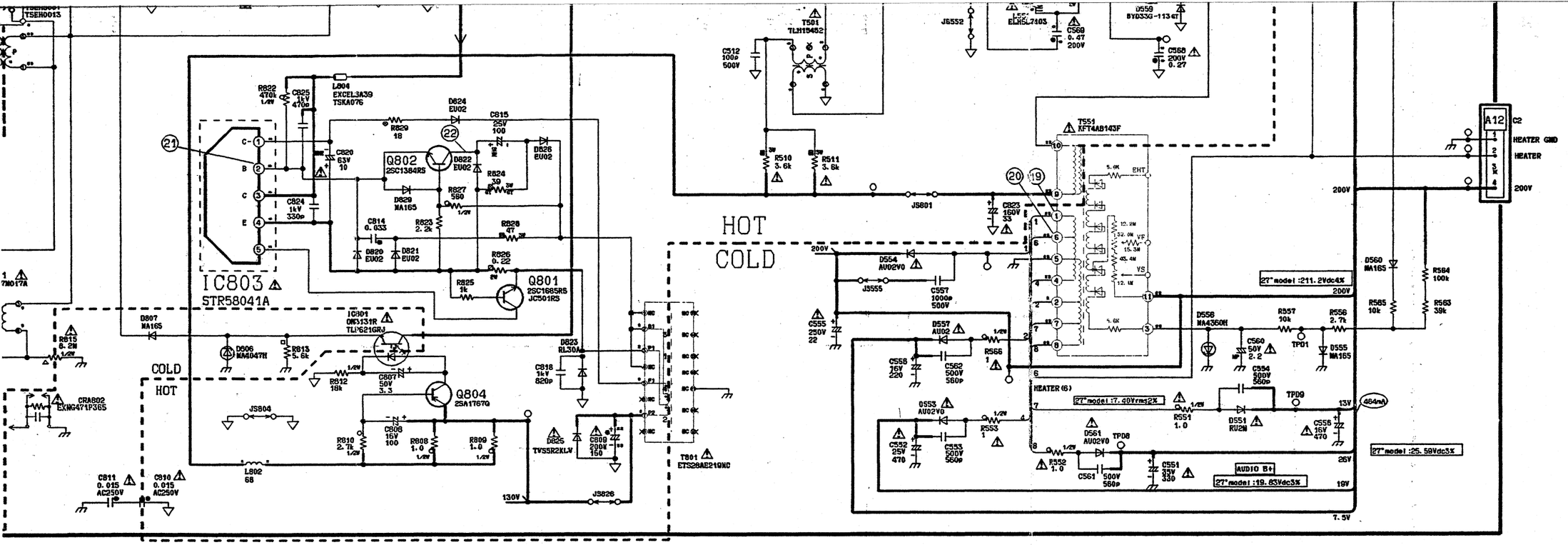
NECK PROTECTOR

H. DRIVE

V. OUT

A12

HEATER GND



Voltage Measurements A–Board

27	4.31
28	3.19
29	2.61
30	2.97
31	5.26
32	2.05
33	2.77
34	2.61
35	3.35
36	3.35
37	8.83
38	3.93
39	4.15
40	2.82
41	4.23
42	4.90
43	4.38
44	0.00
45	0.35
46	6.13
47	4.13
48	2.22
49	5.41
50	0.89
51	6.22
52	4.03

IC552

01	8.05
02	0.00
03	4.92

IC002

01	0.00
02	0.00
03	0.00
04	0.00
05	3.73
06	3.67
07	0.00
08	5.15

IC451

01	8.74
02	4.03
03	4.38
04	4.44
05	0.02
06	4.37
07	4.27
08	27.00
09	2.97
10	1.32
11	0.02
12	16.82
13	27.94

IC2201

01	0.00	15	3.74
02	3.73	16	4.46
03	3.67	17	4.50
04	0.12	18	4.41
05	0.10	19	0.70
06	6.06	20	4.47
07	2.72	21	0.00
08	8.85	22	4.46
09	4.48	23	0.72
10	4.47	24	4.29
11	4.47	25	4.68
12	4.35	26	4.36
13	3.03	27	5.00
14	4.47	28	4.85

IC2303

01	6.30
02	0.00
03	6.31
04	0.02
05	0.69
06	8.80
07	8.86
08	0.00
09	8.95
10	18.87

IC2304

01	6.28
02	0.00
03	6.28
04	0.02
05	0.69
06	8.78
07	8.82
08	0.00
09	8.91
10	18.86

IC803 ⚠

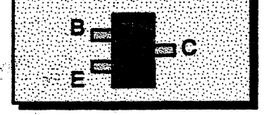
01	0.00
02	0.17
03	3.07
04	0.00
05	132.0

	Q001	Q002	Q003	Q004	Q301	Q302	Q303	Q304
B	0.71	5.82	4.93	5.14	2.96	2.33	1.14	2.77
C	0.06	11.08	5.77	0.00	8.84	8.83	0.00	8.83
E	0.00	5.14	5.79	0.01	2.34	1.74	1.83	2.16

	Q305	Q306	Q307	Q430	Q451	Q452	Q501 ⚠	Q551 ⚠
B	1.67	6.53	1.78	0.36	0.65	0.02	0.00	0.00
C	6.53	1.76	0.00	3.08	0.00	3.65	99.70	127.70
E	1.07	7.14	2.46	0.00	0.00	0.02	0.00	0.00

	Q801 ⚠	Q802 ⚠	Q804 ⚠	Q2309	Q3001
B	0.00	130.60	130.30	6.91	0.00
C	132.00	131.50	0.60	0.00	8.93
E	0.00	131.20	130.70	0.69	0.00

CHIP TRANSISTOR LEAD DESIGNATION



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Board Index
A–Board – Main Chassis
C–Board – CRT Board
Y–Board – PIP Processing

e testing

A–Board Schematic
SP2731W/UW
CT–27G23W/UW/CW & SP2731W/UW

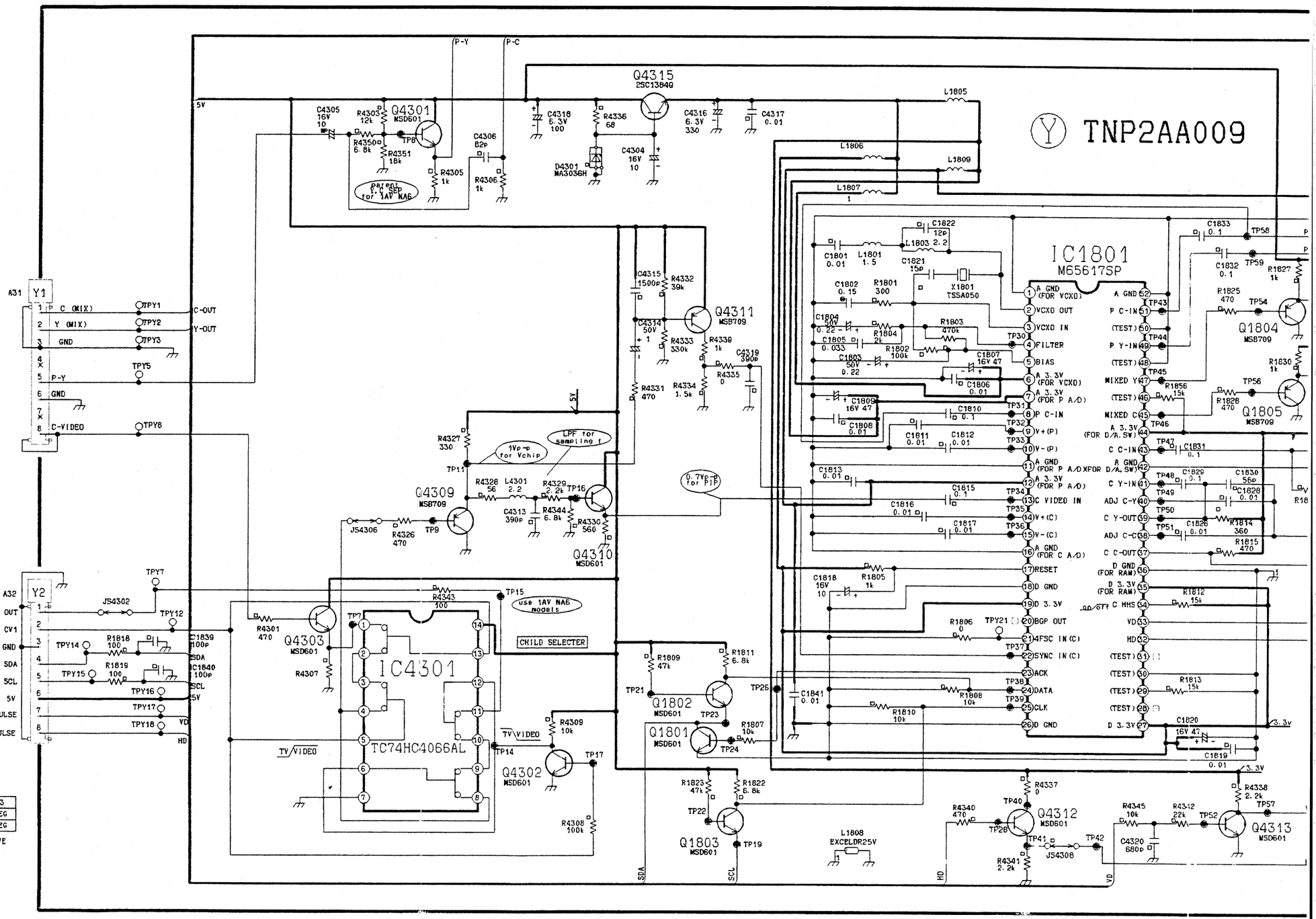
A B C D

1

2

3

Y-Board Schematic
All Models



	GL10C	NA6	P3
V	NEG	NEG	NEG
H	NEG	POS	NEG

PIP NEEDS POSITIVE

Note: Stereo Models

The Functions listed below are activated by a DC voltage change to DAC Inputs(Pin 5 and 6) of MPU IC001. Press and hold a function button on the

Voltage Measurements
Y-Board

Note: Stereo Models

The Functions listed below are activated by a DC voltage change to DAC Inputs(Pin 5 and 6) of MPU IC001. Press and hold a function button on the Receiver to measure voltages.

FUNCTION	PIN 5	PIN 6
POWER	0V~0.443V	N/A
VOL ◀	0.797V~1.07V	N/A
VOL ▶	1.424V~1.696V	N/A
CH ▼	2.05V~2.323V	N/A
CH ▲	2.677V~2.95V	N/A
TV/VIDEO	3.304V~3.576V	N/A
ACTION	N/A	0V~0.443V
SHUT DOWN	N/A	3.930V~5.000V

The AUDIO MODES being broadcast are displayed on screen in red by the voltage change to DAC input (Pin 11) of MPU IC001.

AUDIO MODE BROADCAST	PIN 11 MN1874085TJW
MONO	4.0V~5.0V
SAP	2.2V~3.8V
STEREO	0.9V~1.9V
STEREO & SAP	0V~0.6V

Waveform Measurements

1. ③ indicates waveform measurement. (Measurement can be taken at the best accessible location in common to the indicated point.)
2. Taken with a NTSC signal generator connected to the antenna terminal. (NTSC color bar pattern of 8 bars of EIA colors, 100 IRE white and 7.5 IRE black.)
3. Customer Controls (Picture/Audio Menu) are set to Normalize. Volume is set to "MIN".
4. All video and color waveforms are taken with a wideband scope and a probe with low capacitance (10 to 1). Shape and peak amplitudes may vary depending on the type of Oscilloscope used and its settings.
5. Ground symbol ⏚ shown on waveform number indicates (Hot) ground lead connection of the Oscilloscope. **CAUTION:** Incorrect ground connection of the test equipment will result in erroneous readings.

The waveforms are taken in the order of circuit flow through the various sections as follows:

VIDEO – Waveforms 1~3
COLOR – Waveforms 4~8
VERTICAL – Waveforms 9~13
HORIZONTAL – Waveforms 14~17
CRT DRIVE – Waveforms 18~20
POWER SUPPLY – Waveforms 21~22

Schematic Notes

1. Resistors are carbon 1/4W unless noted otherwise.
2. Capacitors are ceramic 50V unless noted otherwise.
3. Coil value noted is inductance in μH.
4. Test point indicated by ● Test point but no pin ⚲.
5. Components indicated with ⚠ are critical parts and replacement should be made with manufacture specified replacement parts only.
6. ▬ **(BOLD LINE)** Indicates the route of B+ supply.
7. The schematic diagrams are current at the time of printing and are subject to change without notice.
8. Ground symbol ⏚ indicates **HOT GROUND CONNECTION;** ⏚ indicates COLD GROUND.

NOTE: All other component symbols are used for engineering design purposes.

Voltage Measurements
Y-Board

IC1801

01	0.02	27	3.32
02	1.55	28	0.19
03	1.64	29	0.02
04	0.00	30	0.02
05	1.65	31	0.02
06	3.32	32	0.58
07	3.32	33	0.00
08	1.01	34	3.31
09	1.52	35	3.32
10	0.52	36	0.02
11	0.02	37	2.23
12	3.31	38	1.41
13	0.56	39	2.89
14	1.53	40	1.28
15	0.51	41	1.33
16	0.02	42	0.02
17	3.32	43	1.01
18	0.02	44	3.31
19	3.32	45	1.01
20	0.02	46	3.31
21	0.02	47	0.99
22	0.03	48	0.02
23	0.04	49	1.01
24	2.98	50	0.02
25	2.99	51	1.02
26	0.02	52	0.02

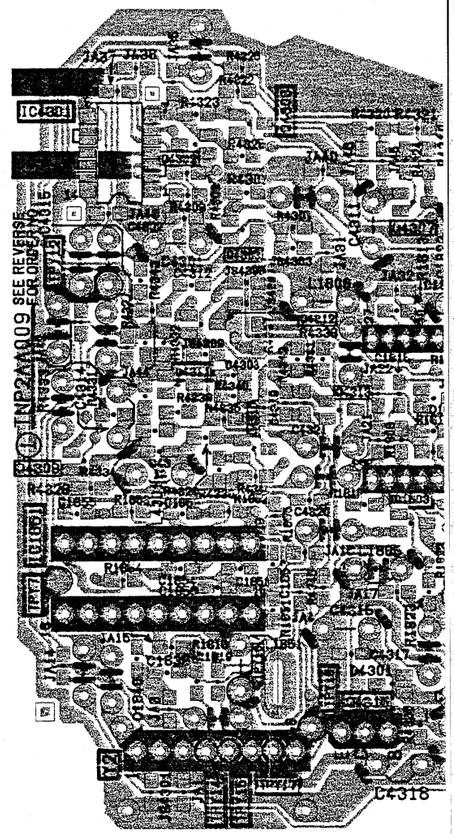
	Q1801	Q1802	Q1803	Q1
B	0.03	3.54	3.54	
C	3.75	2.97	3.01	
E	0.02	3.74	3.67	

	Q4303	Q4309	Q4310	Q4
B	1.70	4.42	3.53	
C	4.89	0.02	4.89	
E	1.12	4.71	2.87	

IC4301

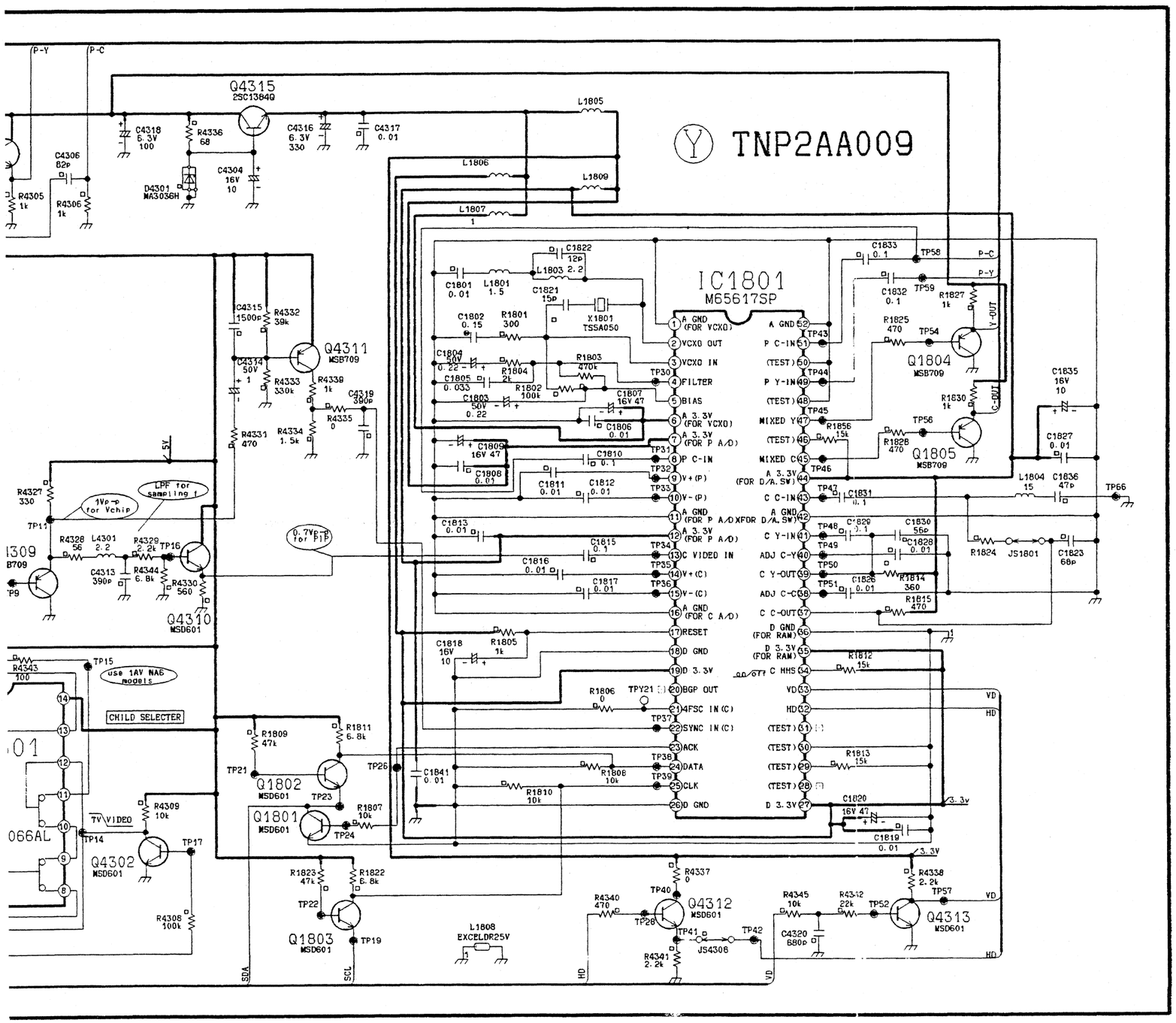
01	1.12
02	1.91
03	1.91
04	4.37
05	0.04
06	4.88
07	0.01
08	4.37
09	4.38
10	4.36
11	4.37
12	4.88
13	0.04
14	4.89

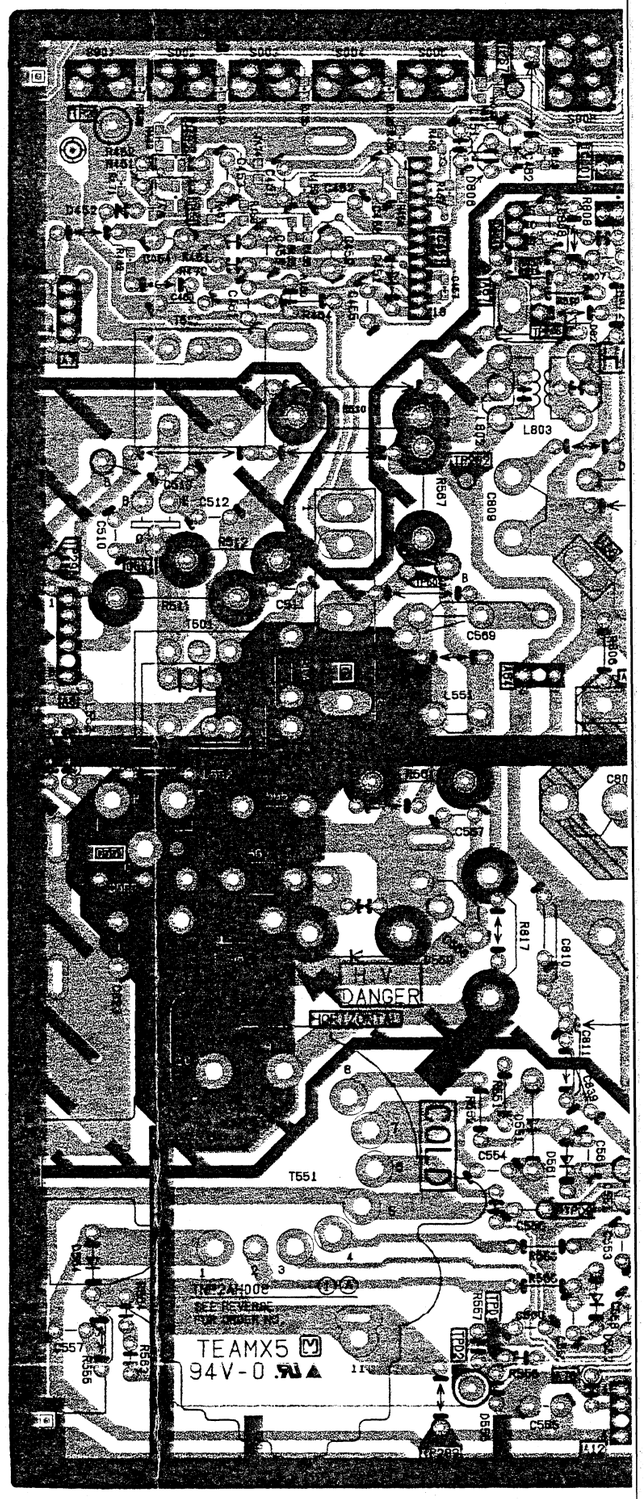
Y-Boar
All M



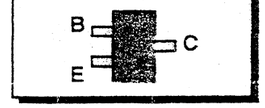
C D E F

Y-Board Schematic
All Models

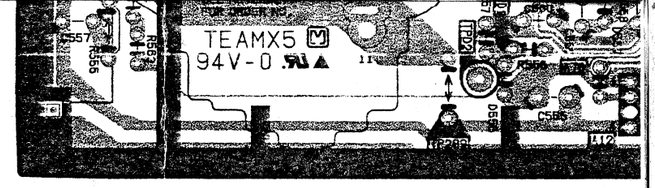




CHIP TRANSISTOR LEAD DESIGNATION



Voltage Measurements



Voltage Measurements
Y-Board

IC1801

01	0.02	27	3.32
02	1.55	28	0.19
03	1.64	29	0.02
04	0.00	30	0.02
05	1.65	31	0.02
06	3.32	32	0.58
07	3.32	33	0.00
08	1.01	34	3.31
09	1.52	35	3.32
10	0.52	36	0.02
11	0.02	37	2.23
12	3.31	38	1.41
13	0.56	39	2.89
14	1.53	40	1.28
15	0.51	41	1.33
16	0.02	42	0.02
17	3.32	43	1.01
18	0.02	44	3.31
19	3.32	45	1.01
20	0.02	46	3.31
21	0.02	47	0.99
22	0.03	48	0.02
23	0.04	49	1.01
24	2.98	50	0.02
25	2.99	51	1.02
26	0.02	52	0.02

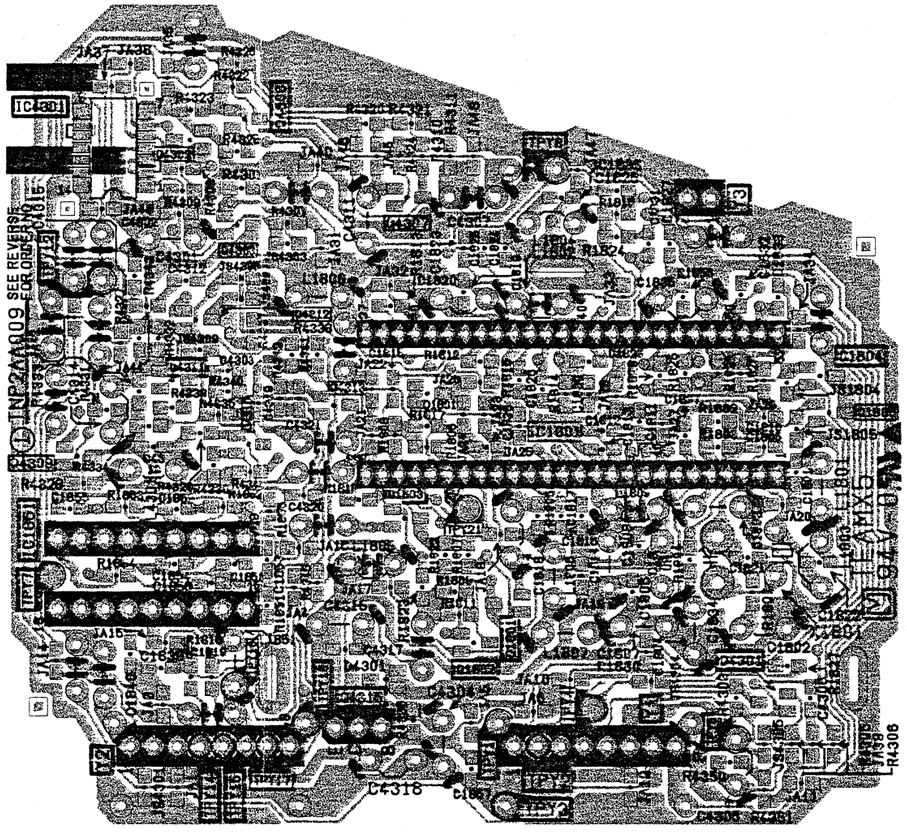
IC4301

01	1.12
02	1.91
03	1.91
04	4.37
05	0.04
06	4.88
07	0.01
08	4.37
09	4.38
10	4.36
11	4.37
12	4.88
13	0.04
14	4.89

	Q1801	Q1802	Q1803	Q1804	Q1805	Q4301	Q4302
B	0.03	3.54	3.54	1.00	1.02	2.87	0.03
C	3.75	2.97	3.01	0.02	0.02	4.89	4.88
E	0.02	3.74	3.67	1.67	1.69	2.24	0.02

	Q4303	Q4309	Q4310	Q4311	Q4312	Q4313	Q4315
B	1.70	4.42	3.53	4.36	0.09	0.65	0.02
C	4.89	0.02	4.89	0.04	3.32	0.12	4.02
E	1.12	4.71	2.87	4.89	0.58	0.02	0.02

Y-Board Layout
All Models



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Tuner Voltage Chart

Enable, Data, and Clock have no DC readings. They are digital signals from the MPU.

NOTE: Voltage at the 30V test pin varies with channel selection. Refer to chart for sample tuning voltages of TV/CATV(CABLE) channels as shown.

Voltage Reading Are Nominal And May Vary ± 15%

- VHF -	
Ch. 02	4.0V
Ch. 06	8.2V
Ch. 07	7.0V
Ch. 13	9.3V

- UHF -	
Ch. 14	7.7V
Ch. 69	24V

- CABLE -					
1st Band		2nd Band		3rd Band	
Ch. 1	6.7V	Ch. 16	4.5V	Ch. 47	3.7V
Ch. 15	24.7V	Ch. 46	2.70V	Ch. 94	14.9V
Ch. 95	9.8V			Ch. 100	15.1V
Ch. 99	17.5V			Ch. 125	24.0V

MICROPROCESSOR PROGRAMMING FOR BAND TUNING/SWITCHING

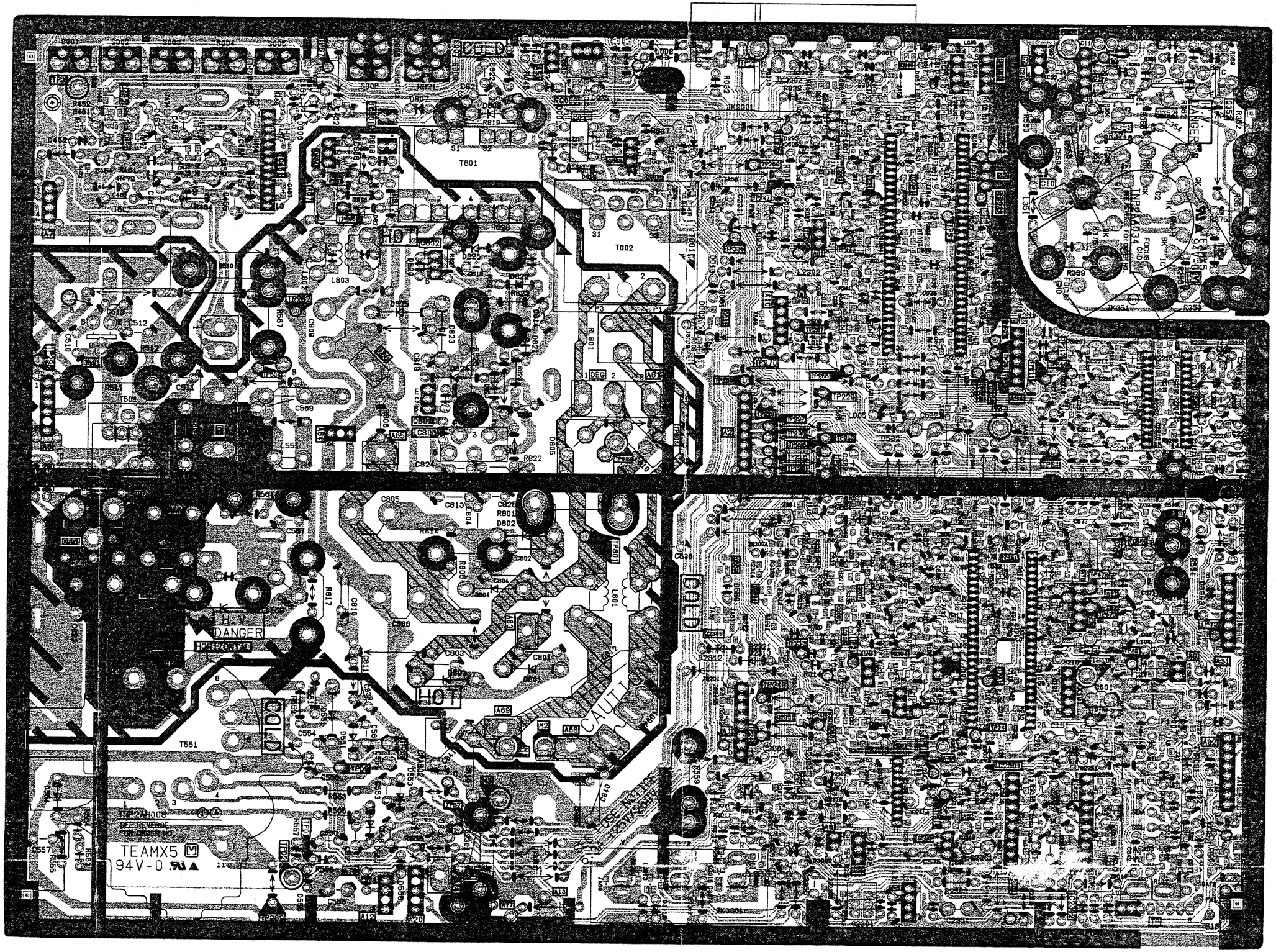
54MHz ↔ 130MHz ↔ 360MHz ↔ 806MHz

	FIRST TUNING BAND	SECOND TUNING BAND	THIRD TUNING BAND
VHF	02~06	07~13	
UHF			14~69
CABLE	01~06,14,1 5, 95~99	07~13, 16~46	47~94, 100~125

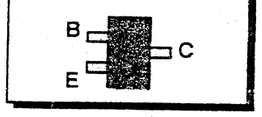
NOTE: CABLE channel numbers as recommended by the joint EIA/NCTA Engineering Committee and published as EIA INTERIM STANDARD NO. 6 – CABLE TELEVISION CHANNEL IDENTIFICATION PLAN – MAY 1983.

A-Board Layout

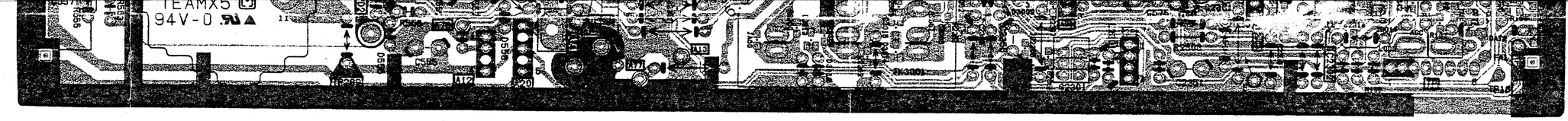
C-Board Layout



CHIP TRANSISTOR LEAD DESIGNATION

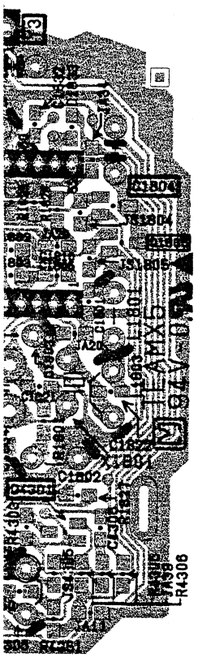


Voltage Measurements



Q4302
0.03
4.88
0.02

Q4315
0.02
4.02
0.02



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Tuner Voltage Chart

Enable, Data, and Clock have no DC readings. They are digital signals from the MPU.

NOTE: Voltage at the 30V test pin varies with channel selection. Refer to chart for sample tuning voltages of TV/CATV(CABLE) channels as shown.

Voltage Reading Are Nominal And May Vary ± 15%

- VHF -	
Ch. 02	4.0V
Ch. 06	8.2V
Ch. 07	7.0V
Ch. 13	9.3V

- UHF -	
Ch. 14	7.7V
Ch. 69	24V

- CABLE -					
1st Band		2nd Band		3rd Band	
Ch. 1	6.7V	Ch. 16	4.5V	Ch. 47	3.7V
Ch. 15	24.7V	Ch. 46	2.70V	Ch. 94	14.9V
Ch. 95	9.8V			Ch. 100	15.1V
Ch. 99	17.5V			Ch. 125	24.0V

MICROPROCESSOR PROGRAMMING FOR BAND TUNING/SWITCHING

54MHz ◄► 130MHz ◄► 360MHz ◄► 806MHz

	FIRST TUNING BAND	SECOND TUNING BAND	THIRD TUNING BAND
VHF	02~06	07~13	
UHF			14~69
CABLE	01~06,14,15, 95~99	07~13, 16~46	47~94, 100~125

NOTE: CABLE channel numbers as recommended by the joint EIA/NCTA Engineering Committee and published as EIA INTERIM STANDARD NO. 6 – CABLE TELEVISION CHANNEL IDENTIFICATION PLAN – MAY 1983.

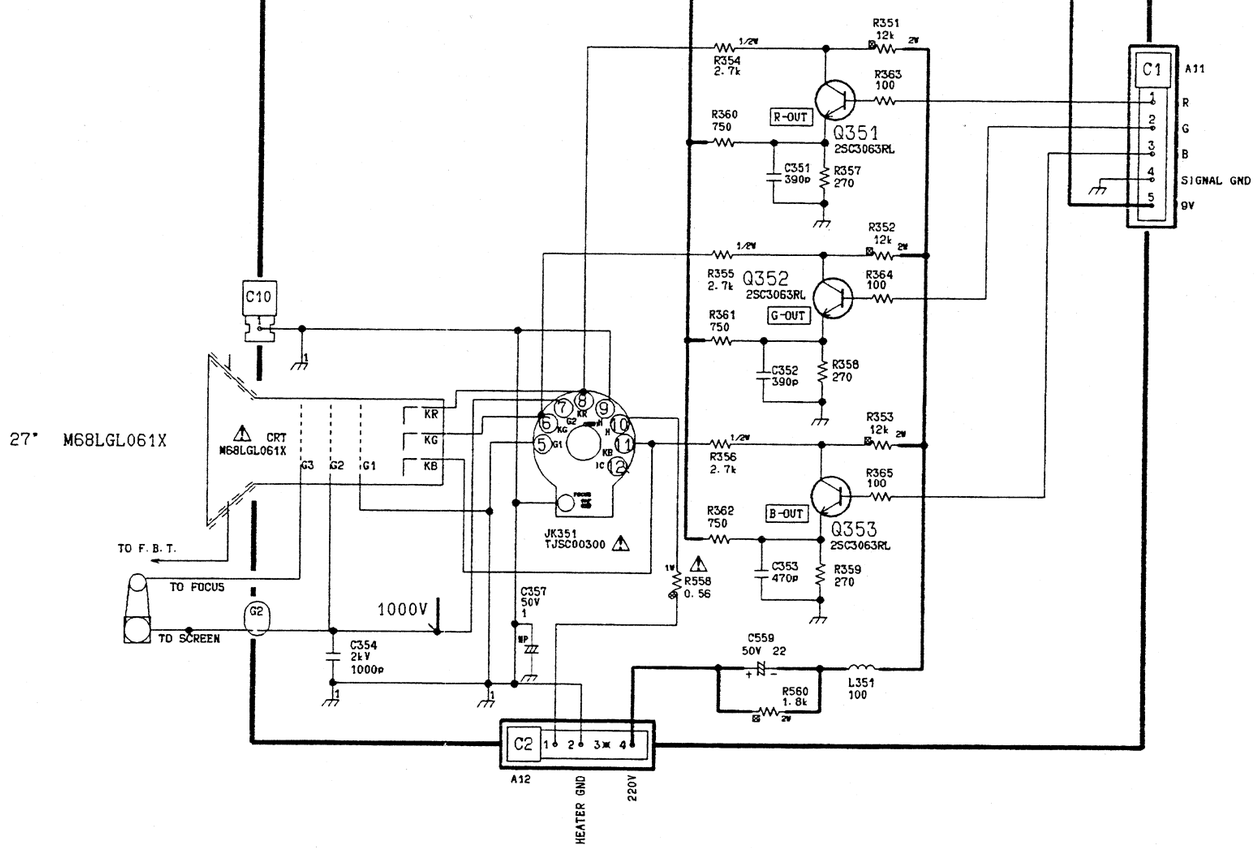
Voltage Measurements

1. Voltage measurement:
   - AC input to the Receiver is 120V. NTSC generator is connected to the antenna of the Receiver. (Color bar pattern of 100IRE white and 7.5 IRE black.)
   - All Picture and Audio adjustments are set to Normalize.
     TV ANT/CABLE – (Set-Up Menu) in TV/ANT Mode
     Volume – Min
     TV/Video SW – TV position
     Audio Mode – Stereo
   - Voltage readings are nominal and may vary ±10% on active devices. Some voltage reading will vary with signal strength and picture content.
   - Supply voltages are all nominal.
2. Ground symbol ⏚ indicates ground lead connection of meter.
   Caution: incorrect ground connection will result in erroneous readings.

Voltage Measurements C-Board

	Q351	Q352	Q353
B	3.51	3.41	3.48
C	148.20	152.50	148.10
E	3.33	3.22	3.29

C-Board Schematic All Models



SERVICEMAN MODE (ELECTRONIC CONTROL)
SERVICE ADJUSTMENT VALUES

Model _____ Ser # _____ Date _____

Note: Record the original settings PRIOR to modifying the registers.

Mode	Service Adjustment	Adjustment Range	Def. Val.	Original Value	New Value
Sub Adjustments					
B0	Sub Color	0 ~ 63	33		
B1	Sub Tint	0 ~ 63	33		
B2	Sub Brightness	0 ~ 255	80		
B3	Sub Contrast	0 ~ 63	34		
B4	Killer/ABL/Gamma	0 ~ 7	5		
B5	Video Adjustment	0 ~ 15	8		
B6	Audio Adjustment	0 ~ 31	16		
B7	V-Size	0 ~ 63	20		
White Balance Adjustments					
C0	RED Cutoff	*	0 128		
C1	GRN Cutoff	0 ~ 255	64		
C2	BLU Cutoff	*	0 128		
C3	R Drive	0 ~ 127	64		
C4	Blue Drive	0 ~ 127	64		
C5	YNR Switch	0 ~ 1	0		
C6	AFT	*	0 120		
C7	RF AGC	0 ~ 127	64		
C8	YNR	0 ~ 7	0		
C9	Horizontal-Center	0 ~ 31	16		
Ca	Beam Limit	0 ~ 7	0		
Cb	Y Delay	0 ~ 2	2		

* Adjustment indicated in steps:
0 0 ~ 0 255
1 0 ~ 1 255

Mode	Service Adjustment	Adjustment Range	Def. Val.	Original Value	New Value
Options Adjustments					
S0	PIP Color	0 ~ 127	51		
S1	PIP Contrast	0 ~ 127	47		
S2	Up 1/9	0 ~ 255	25		
S3	Down 1/9	0 ~ 255	146		
S4	Left 1/9	0 ~ 255	11		
S5	Right 1/9	0 ~ 255	104		
S6	Up 1/16	0 ~ 255	25		
S7	Down 1/16	0 ~ 255	163		
S8	Left 1/16	0 ~ 255	11		
S9	Right 1/16	0 ~ 255	119		
Sa	Freerun	**	0		
Sb	Clock Adjustment	0 ~ 255	128		
Sc	Pip Tint	0 ~ 255	224		
Sd	Loudness Compensation	0 ~ 63	52		
MTS Adjustments					
M0	Input Level	0 ~ 63	31		
M1	Stereo PLLVCO	0 ~ 63	31		
M2	Filter	0 ~ 63	31		
M3	Low-level Separation	0 ~ 63	31		
M4	High-level Separation	0 ~ 63	31		

** N/A (Not Applicable--set to 0)

Note: *Some adjustment modes may not be available in some models depending on available options.*